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## Legal Systems, Decisionmaking, and the Science of Earth's Systems: Procedural Missing Links

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# Legal Systems, Decisionmaking, and the Science of Earth's Systems: Procedural Missing Links

Nicholas A. Robinson\*

*Decisionmakers disregard scientific findings regarding environmental conditions, despite recommendations of the 1992 "Earth Summit" in Agenda 21 that science should provide a foundation for sustainable development. Although environmental degradation trends continue to exacerbate, decisionmakers address only selected issues. This Article examines an analytic paradigm for evaluating when decisionmakers are ready to address a problem and describes the catalytic role that scientific information can serve in prompting remedial action. Unless systematic procedures require evaluation of environmental scientific findings in the normal course of decisionmaking, science will continue to be ignored. One hallmark of Environmental Law has been to fashion such procedures, as illustrated by integrative systems developed in international environmental law institutions, environmental impact assessment processes, licensing procedures for nuclear electrical generating facilities, and corporate environmental management.*

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#### INTRODUCTION

A disjunction exists today between how scientists and government leaders view global changes in Earth's natural systems, such as the rapid loss of biodiversity accompanying species extinction or the modification of Earth's climate through global warming. This fault line extends between the institutionalized perceptions of each nation's governmental decisionmakers and the findings of scientists studying the Earth's natural systems, and it needs to be better understood and bridged. While procedural innovations in the procedures for governmental decisionmaking can be nurtured to bridge this gap, such reforms are frequently proposed but rarely realized. Given the ongoing worldwide deterioration of natural systems, the consequence of not enhancing procedures to more effectively integrate scientific knowledge into governmental decisionmaking will be the degradation of living conditions in all parts of the Earth. This Article examines a methodology for analyzing why and when the disjunction, regarding environmental problems, arises between decisionmakers and the scientific community and then proposes procedures designed to bridge this divide and integrate scientific knowledge into political decisionmaking.

Day-to-day pressures require governmental decisionmakers to concentrate their attention on urgently pending matters that require prompt action, leaving little, if any, time for them to focus on or consider scientific knowledge about environmental problems. This is especially true for environmental trends that worsen only gradually and are seen as remote in time or space from the immediate questions pending before decisionmakers. Decisionmakers have little occasion to involve the scientist in their deliberations or actions;<sup>1</sup> the decisionmaker's "world" is a political construct. Political leaders make decisions, within the confines of the decisionmaking procedures they inherit when they take office, based on their perceptions of how best to govern. Their opportunities to forge innovations in procedures are few.

These patterns are not restricted to local authorities or national governments, but are evident among nations in their international relations. National governments claim a sovereign right to determine their own environmental matters.<sup>2</sup> Internationally, this political world rests upon and assumes the continued legitimacy of the system of nation states, whose decisionmakers govern their people, develop their natural resources, manage their economies, and traditionally assign policy priority to national security and free trade.<sup>3</sup> The world's inter-governmental system is based on the role of nation states, as it emerged from the Congress of Vienna in 1815,<sup>4</sup> and was reconfirmed with the founding of the United Nations in 1945.<sup>5</sup> While this formal system has produced a relatively stable world order with respect to trade or military security, its decisionmakers in foreign ministries and inter-governmental

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1. Even where decisionmakers do seek to systematically consider scientific views, as when Congress established the Office of Technology Assessment, there is no assurance they will pay attention to the views, and the more recent decision of the House of Representatives to abolish its Office of Technology Assessment during the leadership of Speaker Newt Gingrich illustrates the hubris that elected leaders often evince. They do not need to study what they think, with untested certainty, that they know.

2. "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." Declaration of the United Nations Conference on the Human Environment, June 16, 1972, Principle 21, 11 I.L.M. 1416.

3. See generally LOUIS HENKIN, *HOW NATIONS BEHAVE* (1979).

4. See INIS L. CLAUDE, JR., *SWORDS INTO PLOWSHARES* 23-28 (2d ed. 1963).

5. See U.N. CHARTER, 59 Stat. 1031, T.S. 993, 3 Bevans 1153.

organizations are constrained in their environmental perspective because of the static definition of nations as geographic places—assuming a constancy in climate, coastal and river patterns, and natural resources in general.<sup>6</sup> While population growth and natural resource depletion place stress on the capacity of a number of nations to govern,<sup>7</sup> these pressures have not yet induced nations to fashion new decisionmaking institutions that can better address the problems generated by these shared phenomena. National decisionmakers persist in asserting their sovereign nation-state prerogatives. These decisionmakers make little time to consider scientific analysis of trends in biodiversity loss, pervasive land erosion, or the rise in sea levels.

In contrast, scientists concern themselves with the biological, physical, and chemical characteristics of Earth and its natural system. Scientific inquiry is not delineated or demarcated by political boundaries. Although theoretical and empirical scientific inquiry proceeds independently of political decisionmaking, contemporary scientific research has documented such fundamental changes in the functions of the Earth's many natural systems that the resulting worldview for decisionmakers and scientists alike can only be characterized as revolutionary.<sup>8</sup> Contemporary scientific analysis of environmental degradation trends implicitly calls into question many of the assumptions underlying how governments currently manage natural resources.<sup>9</sup> In light of the pervasive physical changes occurring in nature, the scientific community perceives that the prevailing governmental policies on the use of natural resources require reassessment.<sup>10</sup> Most governments, however,

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6. Under international law, a state is defined as having a territory and a people. Despite occasional border disputes, the geographic focus of national governments is settled. Government's primary concern is within the environmental conditions within its borders, and not with global trends or geographically remote conditions. See RESTATEMENT (THIRD) OF THE FOREIGN RELATIONS LAW OF THE UNITED STATES § 201 (1987).

7. The phenomenon of desertification illustrates this point. While areas across central Africa erode and deserts spread across national borders, no regional approach is taken; the Convention to Combat Desertification, while in force, is weakly financed and little implemented.

8. See generally, Agenda 21, June 13, 1992, ch. 35, U.N. Doc. A/Conf. 151/26 (Vol. D III) [hereinafter Agenda 21].

9. See, e.g., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SECOND ASSESSMENT REPORT: CLIMATE CHANGE 1995 (1995), available at <http://www.ipcc.ch/pub/reports.htm>.

10. For a collection of the scientific evaluations regarding environmental policy, see U.S. POLICY AND THE GLOBAL ENVIRONMENT: MEMOS TO THE PRESIDENT (Donald Kennedy & John A. Riggs eds., 2000).

have not yet heeded the scientific community's recommendations for structuring reform.

Given the reality that relatively few national or international governmental resources are allocated to responding to global environmental changes, it is becoming evident that innovations in legal, economic, and social patterns must be fashioned. Current governmental decisionmaking systems fail to effectively confront or ameliorate the environmental degradation trends that scientists record as emerging in all regions of Earth. Few decisionmakers are educated in the natural sciences, and the procedures guiding deliberations by governments make little provision for considering scientific findings. Indeed, a kind of "ecological illiteracy" is found among government leaders. This, in turn, stimulates a resistance or lack of receptivity to considering reforms appropriate to address the gradual and global trends in environmental conditions affected by human activities. Many political authorities, in every nation, are as unprepared to embrace this new environmental worldview as were their distant predecessors who relied on cartographers who "knew" that the world was flat, or those who, before Copernicus, held that the Earth was the center of the solar system, or those who could not fathom Charles Darwin's *Origin of Species*.<sup>11</sup>

More than a lack of understanding underlies this disjunction between new scientific environmental knowledge and the resistance among many governmental decisionmakers to accept the implications of such knowledge. The force of tradition and accepted expectations deters change. The power of political inertia makes it unlikely that major reforms will be undertaken in response to long-range environmental threats. The objective importance of new scientific findings alone does not induce a response by governmental decisionmakers. When government decisionmaking is static, the weight of its traditional and accepted decisionmaking procedures can virtually eclipse scientific recommendations for societal reforms that are designed to reflect changing physical conditions in Earth's natural environment. Confident in the empirical basis for their findings, the leadership in the scientific community, and those who urge reforms on the basis of scientific analysis,<sup>12</sup> are troubled that many government decisionmakers around the world tend to

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11. CHARLES DARWIN, *ORIGIN OF SPECIES* (Harvard Univ. Press, 1964) (1858).

12. For instance, many environmental non-governmental organizations have developed strong advocacy programs based upon their understanding of scientific findings on international environmental scientific studies, such as the reports of the Intergovernmental Panel on Climate Change.

marginalize their concerns. Inertia, accompanying the "business as usual" predilections among government decisionmakers, is sufficiently strong that it precludes serious responses to scientifically premised recommendations for societal reforms that either are designed to *curb* those human activities that contribute to negative environmental trends or are designed to *adapt* settled activities so that they can accommodate changing and new physical conditions.

Although recognition of this disjunction spawns well-intended and intelligent proposals for inclusion of more scientific information in decisionmaking, the recommendations rarely result in institutional reforms.<sup>13</sup> Perhaps the closest that scientists and senior governmental decisionmakers have come to bridging the gap that divides them may be the agreement on proposals entitled "Science for Sustainable Development,"<sup>14</sup> which were adopted at the 1992 United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, known popularly as the "Earth Summit." These recommendations are part of the action plan, *Agenda 21*, that UNCED adopted:

This chapter focuses on the role and the use of the sciences in supporting the prudent management of the environment and development for the daily survival and future development of humanity. . . . One role of the sciences should be to provide information to better enable formulation and selection of environment and development policies in the decision-making process. In order to fulfill this requirement, it will be essential to enhance scientific understanding, improve long-term scientific assessments, strengthen scientific capacities in all countries and ensure that the sciences are responsible to emerging needs.<sup>15</sup>

The report by the National Research Council's Board on Sustainable Development, entitled *Our Common Journey: A Transition Toward Sustainability*, elaborated on these recommendations.<sup>16</sup> On their merits, the learned and sensible recommendations in this report, discussed in Professor William

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13. See, e.g., COUNCIL ON ENVTL. QUALITY, GLOBAL 2000 REPORT TO THE PRESIDENT (1981) (an analysis of scientific aspects of global trends in environmental degradation together with their implications, prepared during the Carter Administration, which was not acted upon).

14. See generally *Agenda 21*, *supra* note 8.

15. *Id.* ¶ 35.1.

16. See generally BD. ON SUSTAINABLE DEV., NAT'L RESEARCH COUNCIL, *OUR COMMON JOURNEY: A TRANSITION TOWARD SUSTAINABILITY* (1999) [hereinafter, *OUR COMMON JOURNEY*].

C. Clark's article in this symposium,<sup>17</sup> deserve serious consideration. It remains to be seen, however, whether the report will receive any more of an effective governmental response than have the similar recommendations contained in *Agenda 21*, or have any previous suggestions for coping with global environmental degradation.<sup>18</sup>

Before one can assess how to ensure that the Board on Sustainable Development's recommendations are likely to be implemented, it is necessary to consider some difficult questions. First, despite the consensus expressed in *Agenda 21*, why has relatively little been done to develop procedures that could ensure that scientific advice is assembled and prepared to inform policymaking, especially since *Agenda 21* states that "the role and the use of the sciences in supporting the prudent management of the environment and development" is integral to the "daily survival and future development of humanity?"<sup>19</sup> Although the Earth Summit was the largest intergovernmental conference ever assembled, with 116 heads of state or government and 8,000 accredited ministers and diplomats representing 172 nations,<sup>20</sup> the follow-up by most nations has been markedly modest.<sup>21</sup> Second, why is so little public attention devoted today to the recommendations of the 1992 Earth Summit meeting? Third, what can or should practitioners of environmental law or governmental decisionmakers do to better assess and utilize scientific knowledge? Fourth, what decisionmaking procedures could be fashioned to induce governments to respond to scientific recommendations regarding protection of the global environment?

If this Article cannot definitively respond to such inquiries, it can at least chart some of the issues that need further analysis. The thesis of this Article is that the highest councils of government will not give immediate attention to scientific information unless either: (a) there is a politicized event—such as a catastrophe or a dramatically perceived threat to human well-being—that galvanizes existing governmental

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17. William C. Clark, *A Transition Toward Sustainability*, 27 *ECOLOGY L.Q.* 1021 (2001).

18. See the recommendations of the Carter Administration contained in the "Global 2000 Report to the President" (Washington, D.C., 1979).

19. *Agenda 21*, *supra* note 8, ¶ 35.1.

20. See Tommy Thong-Bee Koh, *The Earth Summit's Negotiating Process*, in *AGENDA 21: EARTH'S ACTION PLAN* xiii (N. A. Robinson ed., 1993).

21. National reports on implementation of *Agenda 21* are part of the annual deliberations of the United Nations Commission on Sustainable Development and can be reviewed at the United Nations' website. See generally <http://www.un.org>.



decisionmakers into action; or (b) there are clear, easily enforceable legal procedures that *systematically* make the consideration of scientific knowledge an unavoidable element of decisionmaking. Since the event of a catastrophe, such as the flooding induced by El Niño events in Central and South America, causes enormous loss of human life and damage to both the natural and built environment, there should be every incentive to avoid the loss by selecting the second approach.<sup>22</sup>

Conceiving, employing, and refining procedures lies at the core of environmental law.<sup>23</sup> Indeed, perhaps the most significant contribution that the field of environmental law has made to jurisprudence has been to fashion legal procedures that effectively integrate scientific knowledge into the governance framework. This Article identifies several effective processes, in a variety of illustrative legal contexts, whereby scientific knowledge is incorporated as a part of environmental decisionmaking. The Article explores an analytic model composed of four stages of political environmental awareness; the model facilitates predicting whether and when decisionmakers will weigh and act upon scientific knowledge. Having defined the model, the Article then illustrates its operation with reference to environmental governmental decisionmaking operating in systems of international law, national law, and in the private sector operations of the environmental and health and safety management practices of multinational corporations. The Article concludes by suggesting responses to the questions as to why society ignores the environmental knowledge developed by scientific studies of the Earth's natural systems.

Dr. Clark's article outlines many prudent socio-economic reforms indicated by "sustainability science."<sup>24</sup> Whether or not a society and its governmental decisionmakers will be ready to

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22. President George Bush and his Secretary of State, James Baker, had formulated a foreign policy in support of the United Nations Framework Convention on Climate Change known as the "No Regrets" policy. If reforms, such as coastal zone management procedures to anticipate the damage from storm surges and better protect the upland areas, could be adopted that made good sense and also anticipated climate change and sea level rise, then these measures should be adopted. Similarly, if energy efficiency measures avoid waste of energy resources and averted the introduction of more carbon dioxide as a greenhouse gas, then incentives for energy efficiency should be advanced. This policy was not advanced during the Clinton Administration's years, which favored a more aggressive approach toward reducing greenhouse gases.

23. This has been so since the earliest undertakings to define the new field of environmental law. See David Sive, *Some Thoughts of an Environmental Lawyer in the Wilderness of Environmental Law*, 70 COLUM. L. REV. 612 (1970).

24. Clark, *supra* note 17.

adopt any of these reforms depends upon the general societal level of environmental awareness of a given environmental problem. Procedures established within environmental law can serve to build that environmental awareness. Understanding the state of environmental awareness can guide the advocate of environmental reform in knowing strategically which procedures to employ. The model of four stages of environmental awareness discussed below can provide insights into when and how a decisionmaker's comprehension of an environmental problem can be advanced from the point of ignoring scientific knowledge to the point at which decisionmakers find scientific knowledge a necessary component in considering and acting to address an environmental problem. Ultimately, recourse to the model can help both the scientist and the lawyer to refine how the *systems* of governance integrate environmental science with decisionmaking.<sup>25</sup> Until formal procedures systematically require analysis of scientific considerations at the point at which governments make decisions, there is little likelihood that decisionmakers will take the time to study and understand how environmental sciences can contribute to effective decisionmaking.

## 1

## CHANGE AND DENIAL: WHY IGNORE SCIENCE?

Logically, the findings of the scientists who study Earth's natural systems should alarm us. Today, Earth's natural systems are changing at rates that confound historic assumptions about what is normal. Accepted wisdom about the Earth's physical conditions is no longer scientifically reliable because of rapid global changes. This is true for the placement of coastal lines, patterns of rainfall and what crops may be planted, migration patterns of species, or the artificial introduction of alien species into remote ecosystems.

Earth's polar regions demonstrate this fact most dramatically. For the past several years, vast portions of the Ross Ice Shelf of Antarctica have been breaking off, sending

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25. Some governments have begun to make significant changes in the institutional structures of government in order to enable more systematic consideration of the environment when decisions are made on economic, social, fiscal, energy, agricultural transportation, trade, and other policies, as well as the implications of policies in these areas for the environment. See Agenda 21, *supra* note 8, ¶ 8.2. Agenda 21 also recommends that states enact procedural changes in laws to advance such integration. See *id.* ¶ 8.4. Agenda 21 also calls for the design and use of "integrated management systems." *Id.* ¶ 8.5 (d).

icebergs the size of Connecticut or Belgium into the South Antarctic Sea.<sup>26</sup> The effect at the North Pole is even more dramatic. The ice coverage of the northern polar region is receding rapidly. Scientists at the Nansen Environmental and Remote Sensing Center of the University of Bergen in Norway have calculated that the north polar ice cap is melting at such a rate that the Arctic may be free of ice in the summertime within the next fifty years.<sup>27</sup> Global warming of the atmosphere as a result of the emission of carbon dioxide and other "greenhouse" gases is often cited for destabilizing the ice and snow cover of both poles. Change of such magnitude suggests both that the trends are irreversible and that, in turn, they will induce many other reactions in Earth's natural systems and human development. For example, ocean currents may shift, with attendant climatic alterations along coastal areas.

If human society is to understand and cope with this unprecedented rate of change in Earth's systems, it will first need to devote more substantial resources to scientific studies of Earth's natural systems. Then, in light of what is learned, society will need to encourage appropriate adaptation of human activities. "Sustainability Science" can chart Earth's environmental problems; from that knowledge, governmental decisionmakers can establish measured legal reforms employing alternative or emerging technologies. If scientific knowledge is integrated into decisionmaking, then governmental systems can facilitate the adaptations in socio-economic realms that are needed to competently adjust to global environmental change.

Yet if this is to be, one may ask *when* will Earth's legal and political institutions accept the emergence of this new global era of environmental change? When will nations make new commitments to both learning from the sciences and developing social and engineering innovations to cope with the environmental problems? The answer to this question of timing is problematic. One response is fraught with unpleasantness, since reforms tend to be adopted in response to catastrophes. Acceptance of a new framework may emerge only *after* human society endures a number of tragedies, exacerbated by failure to understand the new natural conditions on Earth. After a vast natural disaster with irreversible impacts, such as Hurricane

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26. Theodore Scambos, *Satellite Images Show Chunk of Broken Antarctic Ice Shelf*, ASSOCIATED PRESS, AP Online, April 16, 1998, at <http://www.eurekalert.org/releases/brkantartice.html>.

27. See Walter Gibbs, *Research Predicts Summer Doom for Northern Icecap*, N.Y. TIMES, July 11, 2000, at F2.

Mitch's devastation of Central America or the destruction of the Aral Sea, there are calls to "never let it happen again." Given the growth in human population, especially in urban settings situated along coastal regions that are predicted to be affected by climate change, the potential scale of death and destruction from a natural disaster like a typhoon, hurricane, or tsunami reaches appalling dimensions. Why then is there such modest interest by decisionmakers to avert such catastrophes?

Before an environmental catastrophe takes place, there is complacency born of an optimism that can be termed "unconscious incompetence." Both the public and decisionmakers share this complacency. The attitude assumes that everything will continue to be "OK" as it has been in the past. Despite the warnings of distinguished *scientific* panels, such as the Intergovernmental Panel on Climate Change,<sup>28</sup> and the predictions of scientific institutions such as at the University of Bergen, the world's political leaders have barely begun to perceive that Earth's environmental changes will affect their nations. Without such understanding, national decisionmakers evince little interest in launching or financing further scientific studies of global change associated with the warming of Earth's atmosphere. Similarly, despite the grave implications of scientific studies documenting an increasing rate in the extinction of species and the loss of biological diversity caused by human society's physical intrusions into natural areas, social reforms to halt this loss continue to proceed slowly.

Decisionmakers' resistance to altering "business as usual" due to a lack of knowledge and awareness or inertia is reinforced by the perceived commercial gain from development. The reluctance to change consumption patterns and traditional energy expenditures is well established, since short-term profit is still possible despite dire long-term prospects for some natural resources. For instance, sturgeon poaching in Russia, which serves an international black market in caviar, is driving this species to extinction. Commercial marine fish stocks have collapsed in both the North Atlantic and North Pacific Oceans due to continued over-fishing. Even when a resource is being lost, along with any hope of profit from it, those unaffected by the loss have a great capacity for ignoring the problem. For example, in some parts of Earth, the loss of soil resulting from erosion and expansion of deserts has reached acute proportions.

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28. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE: THE IPCC SCIENTIFIC ASSESSMENT (J. Houghton et al. eds., 1990).

Despite this crisis, nations have made minimal efforts to abate the problem or to encourage scientific study of soils and desertification phenomena.

Since most of Earth's human population is located within cities, the decisionmakers in urban settlements should be keenly interested in the implications of global change upon human welfare. Urban leaders, however, largely ignore the implications of global change. In burgeoning conurbations, cities plan for growth without much—if any—consideration of the ambient changes in Earth's natural systems. As a result, the lack of potable water, adequate sanitation, minimally decent housing, and open space denies increasingly large numbers of people the basic needs of civilized life. Although pressing local problems associated with their growth understandably preoccupy local governments, eventually the changes in Earth's natural systems will need to be addressed.

Since it is more difficult to ameliorate problems when they become acute, prudent decisionmaking would try to identify trends toward deteriorating conditions and take action before conditions approach the point of irreversible harm. That such prudence is not practiced is strong evidence of a lack of any procedures in governmental decisionmaking that induce cautious behavior. For instance, in the case of cities and other human settlements, it is easier for decisionmakers to leave in place obsolete storm water collection and dispersal systems than to replace them; most local decisionmakers lack a process enabling them to anticipate and adapt to anticipated changes.<sup>29</sup> Even now, with documented changes in rainfall patterns, the storm drains that were designed for handling waters typical of the "historic" 100-year flood are overwhelmed every decade by storms that meet or exceed such design standards. Coastal erosion rates increase with rising sea levels and storm surges are no longer buffered by wetlands and barrier islands. The natural buffering effects of these areas have been lost due to their

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29. Environmental impact assessment, discussed *infra*, provides such a process, and some local authorities use it well to cope with changing environmental conditions. New York City adopted the first municipal environmental impact assessment (EIA) ordinance in 1969 and has systematically refined it since. The NEW YORK CITY, CITY ENVIRONMENTAL QUALITY REVIEW TECHNICAL MANUAL (Dec. 1993, Mayor's Office of Env'tl. Coord.) provides professional, non-regulatory best management practices for the scientific data gathering and assessment of projects and actions planned to take place in New York City. Few municipalities have followed the example of New York City in this respect.

development into human settlements.<sup>30</sup> Historic landmarks, such as the world heritage site of Venice, once thought preserved, will again become endangered by rising sea levels. Many “factual” assumptions that underlie established land use and zoning laws will become doubtful if not wholly inapplicable. In each instance, the decisionmakers’ reluctance to confront the changing environmental conditions places their societies at risk.

Just as the conditions supporting human settlements will change, so too will natural habitats sustaining flora and fauna. Laws for conserving nature attempt to establish procedures to address deterioration of natural systems,<sup>31</sup> but the problems outpace the legal regimes. Slow trends—such as global warming—or rapid change—such as conversion of wild lands to development—alter the habitats in which migratory species of birds, mammals, and fish evolved and induce new ecological arrangements. Such ecological rearrangement may carry enormous implications for human attempts to harvest the remnant wild species (mostly fish) and to sustain agriculture and silvaculture. Alterations in habitat conditions will stress the dwindling stocks of many species. Although new patterns of evolution may emerge, the variety and number of species threatened with extinction is likely to increase, rendering the premise for existing endangered species legislation problematic. Traditionally, flora and fauna were the domain of each nation. The loss of biodiversity on a global scale, however, has generated a growing consensus internationally that the conservation of nature is a common concern for all nations.<sup>32</sup> Nonetheless, the negative environmental trends continue. What are missing are effective procedures linking decisionmakers, who control actions that impact flora and fauna, to both the scientific knowledge of the negative trends and the growing public concern.

For instance, scientists have ample empirical basis to predict some of the substantial implications for disruption of human

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30. Louisiana currently loses some 65 square miles of its State into the Gulf of Mexico each year. In 50 years, New Orleans could look rather like Venice, a walled island along the Mississippi River channel, surrounded with shallow waters.

31. See Convention on the International Trade in Endangered Species of Wild Flora and Fauna, Mar. 3, 1973, T.I.A.S. No. 8249, 993 U.N.T.S. 243 [hereinafter CITES]; see also Fish and Wildlife Coordination Act, 16 U.S.C. §§ 663-668dd (1994); Endangered Species Act, 16 U.S.C. §§ 1531-1544 (1994) (both Acts seek to protect species from extinction and to maintain habitat). Despite procedures toward these objectives, rates of extinction grow for many species and habitat continues to be lost.

32. For an illustration of growing global concern about the environment, see the Rio de Janeiro Convention on Biological Diversity, June 5, 1992, 31 I.L.M. 818 [hereinafter CBD].

society on Earth, such as will occur during the flooding of heavily populated coastal zones during storms as a result of sea level rise. Nonetheless, despite these extant scientific studies that explain global changes and their impacts on human society, the scientific literature has not galvanized much political consensus in favor of serious remedial action. It is commonplace to attribute this absence of policy and action to a "lack of political will." Indeed, not only is there no political will either to more substantially invest in the scientific studies of the natural changes taking place on Earth or to innovate in ways that adapt to the changes, but there is actual opposition to doing so. One need only examine the rhetoric associated with the refusal of Congress to consider ratification of the Convention on Biological Diversity or the Kyoto Protocol to the U.N. Framework Convention on Climate Change, to confirm the depth of this opposition.<sup>33</sup>

On one level, this opposition may appear as vested economic interests defending their traditional sources of wealth, such as the desire of the oil industry to continue the reliance on petroleum despite its massive contribution to global warming through the release of carbon dioxide and other greenhouse gases. The record of such opposition is well documented in the case of the pesticide industry, which launched virulent attacks<sup>34</sup> against Rachel Carson for her book, *Silent Spring*.<sup>35</sup> Lobbying by the pesticide industry has succeeded, for three decades, in preventing legislation that would curb the use or manufacture of any synthetic organic chemicals used as pesticides despite the evidence that the residues of such chemicals continue as persistent organic pollutants in the ambient environment. Similar industrial opposition rose to confront the initial scientific work of F. Sherwood Rowland regarding the stratospheric ozone layer and chlorofluorocarbons.<sup>36</sup>

Opposition by vested interests deters busy governmental decisionmakers from taking the time to evaluate scientific knowledge about environmental trends, even if legislators or agency officials were disposed to do so. Vested economic interests control decisions over many natural resources, and are

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33. See, for instance, the critique in opposition to the Kyoto Protocol in TERRY L. ANDERSON & J. BISHOP GREWELL, *THE GREENING OF FOREIGN POLICY* 14-17 (2000).

34. See PAUL BROOKS, *THE HOUSE OF LIFE* (1972); see also FRANK GRAHAM JR., *SINCE SILENT SPRING* (1970); Frank Graham, Jr., *The Witch-Hunt of Rachael Carson*, 10 *ECOLOGIST* 3 (1980).

35. See generally RACHEL CARSON, *SILENT SPRING* (1962).

36. See LYDIA DOTT & HAROLD SCHIFF, *THE OZONE WAR* (1978).

particularly ill-suited to define changes in their natural resource practices in order to accommodate new policy to cope with global environmental trends. Even when a renewable natural resource is exploited to the point of extinction, as illustrated by certain fish stocks or water drawn from non-recharging aquifers, many people still desire to be the last one to reap the benefits of the natural wealth, thus resulting in a "tragedy of the commons."<sup>37</sup> While scientists may not be able to define a "bright line" beyond which a renewable resource can be harvested or mined without causing its collapse, the scientific community has ably described the trends of degradation in resources that can lead to that point and have documented the collapse after the fact. Scientific data on trends are sufficient for decisionmakers to adopt prophylactic measures.<sup>38</sup> Why do decisionmakers fail to act? In some cases, decisionmakers affirmatively decide to resist acting; for instance, one may ponder why the U.S. State Department repeatedly resists relying on the "precautionary principle."<sup>39</sup> The precautionary principle is a concept designed to prevent the launch of new trends that could harm the environment. It recites that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."<sup>40</sup> While the precautionary principle is not yet widely accepted as a rule of decision, much less as a core element of a system of international decisionmaking, nonetheless decisionmakers in the State Department consistently resist the progressive development of this legal principle.<sup>41</sup>

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37. See Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243, 1243-48 (1968).

38. The collapse of salmon runs in the Pacific Northwest and of the Atlantic Cod are dramatic examples of the consequences of both the failure of commercial interests to protect the fisheries voluntarily or of government to establish regulatory systems to do so at an early enough point in time to have a salutary effect. On the Cod, see Nicholas Foulkes, *So Farewell to Cod*, FIN. TIMES (London), at xxvi, col. 1-7 (Jan. 6-7, 2001).

39. See Declaration on Environment and Development, June 13, 1992, Principle 15, 31 I.L.M. 874.

40. *Id.*

41. The precautionary principle is contained in the Cartagena Biosafety Protocol to the Convention on Biological Diversity (signed in 1979, not yet in force). Several decisions of state courts in Australia have accepted the precautionary principle as a rule of decision. Notwithstanding these developments, the U.S. Department of State routinely continues to oppose the recognition that the principle should be a rule of law and prefers to recognize it only as an "approach" to consider in making policy. Paul E. Hagen & John Barlow Weiner, *The Cartagena Protocol on Biosafety: New Rules for International Trade in Living Modified Organisms*, 12 GEO. INT'L ENVTL. L. REV. 696 (2000).



Beyond the opposition from economic interests lies a more profound dimension of the resistance to considering scientific knowledge when it challenges the traditional socio-economic assumptions. Today there persists a deeply settled social and philosophical belief in traditional patterns of "progress." This notion of "progress" is based on a liberal market economy and an expectation that Earth's bounty is a "horn of plenty." Any critique of "limits of growth" affronts the worldview that is founded on these convictions, as the authors of the Club of Rome's report by that name discovered in the 1970s.<sup>42</sup> The strident and virulent political criticism of environmentalists by some authors<sup>43</sup> and by some elected officials suggests that they feel personally affronted by the warnings that these environmentalists present. They confuse the message with the messenger and decline to study the scientific basis for the environmentalists' concerns. The Copernican revolution met similar disbelief from established authorities because its message was so contrary to the received wisdom of its day. The consequences of decisionmakers' conscious refusal to accept the current scientific assessments, however, is more perilous than were the consequences in Copernicus' day when the question merely involved matters of faith.

The manifest reasons to discount or disregard scientific knowledge therefore range from inertia, to pecuniary motivations of vested interests, to a philosophical or ideological perception that the scientific information is contrary to "progress" or the order of the day. It should not be surprising that many political and governmental authorities have either ignored or reacted negatively to initial scientific reports about the changes that Earth is experiencing.

Decisionmakers' reluctance to confront this indifference and opposition is compounded by the skeptical nature of scientific inquiry. The scientific community generally agrees that every hypothesis requires critique and scrutiny as part of the scientific method. The skepticism that comprises part of this continuing scientific debate is emphasized by representatives of vested economic interests and by social critics of the environmental community in order to discredit the proposed hypothesis or scientific findings. Journalists, themselves largely untrained in

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42. See generally DONELLA MEADOWS ET AL., *LIMITS TO GROWTH* (1972).

43. See, e.g., RON ARNOLD, *AT THE EYE OF THE STORM: JAMES WATT AND THE ENVIRONMENTALISTS* (1982); DIXY LEE RAY, *ENVIRONMENTAL OVERKILL* (1993); GREGG ESTERBROOK, *A MOMENT ON THE EARTH* (1995).

scientific matters, try to report opposing scientific views in the interests of presenting "balanced" news. Hearing such doubts, in turn, may dissuade political leaders from adopting a policy or agreeing to take action.

In order to anticipate these sorts of pressures on decisionmakers, which militate against considering actions to respond to scientific knowledge about Earth's environmental degradation, there have been efforts to shape procedures and institutions that would require such consideration. The diplomats who negotiated *Agenda 21* were aware that their recommendations might fall on deaf political ears; thus they recommended the establishment of an institution that could keep the deliberations about the issues of *Agenda 21* before decisionmakers. The United Nations General Assembly accepted the recommendation of UNCED that it establish a new United Nations body, the "Commission on Sustainable Development" (CSD). The CSD meets annually in March and April to consider the progress made in the implementation of *Agenda 21*. Although the CSD meets annually, most nations have sent their career diplomats as their delegates to the CSD's deliberations, with some environment ministers also coming for a CSD ministerial session of two or three days. While the CSD is becoming an important forum, neither set of officials has the political authority to determine the basic foreign policy or environmental domestic policies of their home states. The result is that policy deliberations to foster implementation of *Agenda 21* proceed at a snail's pace. Although the CSD has provided unprecedented access and opportunities for non-governmental organizations (NGOs) to argue for sustainability reforms based on scientific reports, the link between what happens at the CSD and in the capitols of the nations is weak; reports flow back to the nations' foreign ministry but often do not reach political decisionmakers. Lacking a consensus, the delegates to the "Rio Plus 5" review of *Agenda 21* in 1997 were not even actually able to agree to some of the recommendations and conclusions that had already been agreed to in *Agenda 21* itself.<sup>44</sup> The CSD has failed to produce an agreement resulting in significant actions in response to the increasingly troubling scientific assessments of the changing circumstances of Earth's natural systems. This is not the fault of the CSD. The CSD is composed of U.N. member

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44. *Programme for the Further Implementation of Agenda 21*, U.N. Earth Summit +5, Special Session, June 23-28, 1997. For instance, no action was prioritized on science for sustainable development.

states whose leaders have not yet chosen to take the scientific assessments more seriously.

The efforts to combat such deep-seated reasons to ignore "sustainability science" have not been sufficient to achieve much integration of science with decisionmaking. Before they can be, it will be necessary to better understand when an environmental issue has matured to the point where the public and decisionmakers seek scientific knowledge and actions in response. Can a more refined analysis be made as to why science is being ignored by governments? Since government is charged with managing the welfare of society based on a sound understanding of relevant factual conditions, should it not be considered incompetent for governmental decisionmakers to ignore the extant knowledge of changes in Earth's natural systems? In order for society's decisionmakers to fashion legal and institutional measures to compensate for their institutional unconscious or conscious incompetence, to acknowledge or address environmental degradation, it will first be necessary to understand the processes that have precluded needed reforms. What is the social and political dynamic for decisionmaking that can take account of the scientific recommendations about Earth's global changes, come to regard them as urgent, and then take appropriate action?

## II

### SCIENCE AND ENVIRONMENTAL AWARENESS IN DECISIONMAKING

#### A. *Common Patterns*

Decisionmaking involving environmental concerns moves through predictable stages. These stages appear throughout the history of environmental law in many nations<sup>45</sup> and tend to follow common patterns.<sup>46</sup> New laws are enacted in response to

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45. For an illustration of the United States' progression through these stages, see, e.g., RICHARD N. L. ANDREWS, *MANAGING THE ENVIRONMENT, MANAGING OURSELVES: A HISTORY OF AMERICAN ENVIRONMENTAL POLICY* (1999).

46. The fact that the patterns are shared is predictable, despite varied cultures and legal regimes. First, natural systems are the same around the world. Varying more by location than by human impact. Second, the technology is rarely indigenous, and designs are developed in North America or Europe and replicated around the world causing the same types of environmental pollution and problems. Third, human nature is much the same everywhere, and the same mistakes about misuse of resources recur around the world. Fourth, through the United Nations' systems of international cooperation, policy approaches to resolve environmental problems tend to be homogenized and prevailing approaches are legitimized. Finally, legal systems have a long tradition, studied through comparative law techniques, of studying each

*perceived* environmental problems. Since environmental problems tend to build up over time, the decisionmakers' recognition of the problem often emerges well after the problem has become acute. Human activities can degrade the ambient environment or natural resources necessary to human life; the public finally demands reforms when it feels that the degraded conditions have become intolerable. In response to this public reaction, the decisionmaking body makes necessary reforms.

These patterns can be seen in New York's history of dealing with environmental problems. For instance, in the 1840s, New York's wells were so contaminated by its privies that water-borne disease racked the city each summer. Scientific inquiry eventually traced the disease to the contaminated drinking water from wells. The political response gave rise to the early public health movement and created the impetus to build a distant reservoir and aqueduct system rivaling that of ancient Rome. Decisionmakers relied upon science to design and deliver potable water and then to manage the reservoir watersheds. Later, in the 1880-1890s, the extensive clear-cutting of timber, large volume of man-made forest fires, resultant erosion in Adirondack Mountains and subsequent flooding of the Hudson River Valley gravely offended New York's citizens. After enacting attempted legislative reforms such as the establishment of a Forest Commission to manage the timber operations in the Adirondacks, little actual improvement has been realized, owing in part to corruption in the timber industry and its regulators. As a result of public indignation, the early conservation movement emerged as a political force in New York. At New York's constitutional convention in 1894, the citizens provided that the "Adirondack & Catskill Forest Preserve" would be "kept as forever wild forest land," thereby constituting the world's first "wilderness area" established by law.<sup>47</sup> Shortly thereafter, New York established the nation's first Conservation Department and institutionalized the reliance on the biological sciences by state government. In 1911, New York's legislature codified the nation's first Conservation Law,<sup>48</sup> which enacted the nation's first systematic environmental management statute.

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other and of copying and then adapting and adopting prevailing legal reforms. Environmental Law, as a relatively new field everywhere, tends to have the same format and approaches. For a description of the parallel elements of environmental legal regimes, see COMPARATIVE ENVIRONMENTAL LAW AND REGULATION (N. A. Robinson ed., forthcoming 2001).

47. N.Y. CONST. art. XIV.

48. 1911 N.Y. LAWS ch. 647 (July 12, 1911).

Over time, a similar pattern can be discerned in several diverse fields at the federal level. Similarities appear in the campaigns to preserve parklands, in the federal management of forests and soils, and in federal programs for the restoration of surface water quality. Perceiving threats from ongoing or threatened natural resource extraction to be endangering the continued natural features of both Yellowstone and Yosemite, conservationists urged Congress to establish the world's first national parks. About the same time, the nation's forests appeared to be in decline, and civic movements emerged calling for better management of the nation's forests. President Theodore Roosevelt called for better stewardship of the forest resources in his 1908 White House Address on Conservation.<sup>49</sup> Subsequently, Congress established the National Forest Service, which institutionalized scientific silvaculture practices.<sup>50</sup>

Similar patterns are evident in response to other types of environmental degradation. For example, as the desertification of great expanses of the Midwest in the "Dust Bowl" became acute, public pressure mounted demanding that Congress react appropriately. Soils blown away from the Midwest actually blotted out the sun one day in Washington, D.C., during hearings on this desertification phenomenon.<sup>51</sup> In response, Congress established the Soil Conservation Service ("SCS"). The Service institutionalized reliance on soils science and succeeded in restoring soil productivity throughout the nation.<sup>52</sup> The Clean Water Act presents another example of public reaction driving political decisionmaking. The acute pollution of rivers, estuaries, and lakes after World War II prompted the public to demand an end to the use of the nation's waters as sewers for industry. As a result, Congress enacted the sweeping and highly effective Clean Water Act of 1972.<sup>53</sup> In each of these illustrations of the development of Environmental Law, there had been ample scientific studies and reports during the years prior to each "crisis." These scientific reports documented the problems but did not motivate public action. Necessary reforms emerged only after an aroused public reacted to a perceived crisis.

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49. See Theodore Roosevelt, *Opening Address by the President*, reprinted in PROCEEDINGS OF A CONFERENCE OF GOVERNORS IN THE WHITE HOUSE, WASHINGTON, D.C. MAY 13-15, 1908 3-14 (1909).

50. For a statutory history of the establishment of the National Forest Service, see GLEN O. ROBINSON, *THE FOREST SERVICE* 21-54 (1975).

51. See FREDERICK R. STEINER, *SOIL CONSERVATION IN THE UNITED STATES* (1990).

52. See 16 U.S.C. § 590 (a - q) (1982) (the "Soil Conservation Act of 1935").

53. See Clean Water Act, 33 U.S.C. §§ 1251-1387 (1994).

While scientific study is necessary to ensure effective environmental management in each illustration of these patterns, science alone was not sufficient to trigger governmental action to protect nature and natural resources. The sciences can identify and describe natural systems, explain how they function, and assist in defining the scientific scope of sustainable use. The scientific literature on such subjects, however, is not widely read outside the discipline that generates it. The scientific findings alone, even if presented to decisionmakers, will not assure consideration of the assessment, much less the actions that may be recommended. When the public perceives that the natural integrity of a resource, or its valued uses, have become threatened, science is necessary to identify the threat. It is the public pressure, however, that generates decisions to consider scientific advice and to act accordingly.

### *B. The Chain Reaction*

This pattern of response to both scientific knowledge and a public demand for action has also been observed and described in the United Kingdom. Based upon British examples, Lord Eric Ashby has identified what he calls a "chain reaction."<sup>54</sup> Lord Ashby notes that objective scientific reports alone are usually insufficient to move policymakers, but when public interest groups dramatize the problem or journalists bring the problem to the attention of the general public, then the decisionmakers are obliged to act. His characterization of this process has three stages:

In the first stage—let us call it the ignition stage—public opinion has to be raised to a temperature that stimulates political action. In the second stage the hazard has to be examined objectively, to find out how genuine and how dangerous it is, and just what is the risk. In the third stage this objective information has to be combined with the pressures of advocacy and with subjective judgments to produce a formula for political decisions.<sup>55</sup>

Lord Ashby views the chain reaction as an initial ignition of the issue followed by submission of expert "inputs," including input from scientists and economists.

From an historical perspective, that point of ignition of the political process becomes all-important. Lord Ashby illustrated

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54. ERIC ASHBY, *RECONCILING MAN WITH THE ENVIRONMENT* 14 (1977).

55. *Id.* at 14-15.

this moment of ignition in his account of how John Simon, appointed in 1848 as the first medical officer for health in London, succeeded in establishing public health reforms to enhance ambient environmental quality in London. Simon was successful because he could explain the link between cholera and dysentery and the contaminated city waters, and also because conditions for rich or poor alike were intolerable. Lord Ashby also notes that Simon had made a comparable case for abating air pollution, but had failed to secure a public perception that the polluted air was a present health hazard or could be cleaned. It would take nearly a century to abate London's air contamination.<sup>56</sup>

Lord Ashby illustrates the operation of the "chain reaction" in describing the drama by which Parliament finally enacted legislation proscribing the dumping of toxic waste:

In 1970 a Royal Commission on Environmental Pollution was appointed, with wide powers of enquiry. Its first task was to survey the state of the environment in Britain. It found evidence of 'fly-tipping,' that is, the illicit dumping of toxic wastes in places not registered to receive them; and it urged the government to tighten the law. Still nothing was done. Throughout 1971 the Royal Commission collected further examples of fly-tipping, and in August it expressed disquiet at the potential danger to water supplies and the government's failure to deal with the matter. The government's reply was that there was too heavy a program of parliamentary business for the matter to be dealt with in the coming session; moreover, there as to be a reorganization of local government that would affect the administrative arrangements, and a comprehensive bill to control pollution was to be introduced sometime in 1974. In October and November of 1971, further pressure was brought on the Minister by the Royal Commission . . . . Still no action was taken, and the Commission drafted a report critical of the government that was published on March 7, 1972. But before that date a new character had appeared in the story. His name was Lonnie Downes. He was a truck driver in a waste-disposal firm . . . . He discovered that some of his mates were being given a bonus of £20 a week for dumping loads of cyanide, chromic acid, caustic soda, phenol, and other noxious substances on delivery tickets that described them as harmless "suds oil". . . . [H]e reported the whole affair to the local branch of the Conservation Society. The Society . . . prepared a detailed report and sent it to the

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56. See *id.* at 23-25.

Secretary of State for the Environment. Still nothing was done. At this point the Conservation Society, having given due warning that it would make the matter public, sent its findings to the press. . . . Pictures of the alleged toxic waste drums appeared in the newspapers. Parliament was forced to hold a special debate on the issue, but the Under Secretary of State still maintained that the parliamentary timetable was too packed for legislation to be introduced before 1974. Toward the end of February 1974 the government knew that the Royal Commission was about to publish its views on toxic wastes; but on February 24 an incident occurred that eclipsed the sober deliberations of a Royal Commission. Thirty-six one-hundred weight drums were discovered in a derelict piece of ground near the town of Nuneaton, on a site where children played. . . . The Department of the Environment hurriedly drafted a bill to control the deposit of poisonous waste. It was read for the first time on March 8, went through the remaining stages on March 16, and passed into law on March 30.<sup>57</sup>

Lord Ashby concluded that banning the fly-tipping of toxic waste illustrates one of the reasons why mere scientific knowledge or advice alone is insufficient to prompt action to remedy a problem. Lord Ashby epitomized his analysis of environmental decisionmaking when he said: "It is one consequence of the astonishing adaptability of man that he has to be persuaded to be dissatisfied about abuses to his environment. To set the chain reaction going is often the hardest task in social reform."<sup>58</sup> A major catastrophe can, of course, be the catalytic agent for the chain reaction; however, most environmental problems grow incrementally. A catalyst is absent until the injury or threat becomes apparent. The acute illness from water-born disease could trigger action, while the insidious, slower, less perceptible illnesses arising from air pollution could not. In contrast, the potential threat of toxic waste irreparably harming innocent children, once understood, affronts society's basic values about protecting the child and is an intolerable threat.

Is not Lord Ashby correct in sensing that it is not easy to excite the decisionmakers among either the public or the government about an environmental threat? This especially implicates global climate threats whose concrete effects may not be experienced for decades to come. Consider that at any one

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57. *Id.* at 19-21.

58. *Id.* at 21.

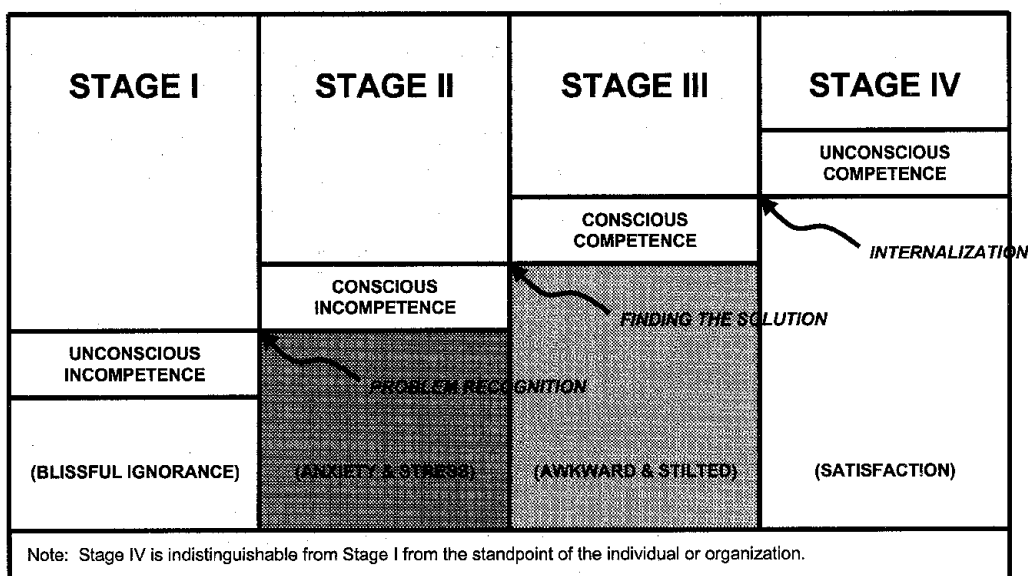


time, there are more environmental trends producing troubling problems than can be addressed by available governmental, commercial, or social leadership. A nation's environmental agenda, or more broadly the "socio-ecological" agenda, must compete with other issues, from the broader socio-economic agenda, to the military and security agenda, to the human rights and liberties political agenda.

The challenge, then, is how to position the knowledge produced from the scientific inquiry about the changes in Earth's natural systems so that it can catalyze the chain reaction and ensure that scientific advice has some priority among the competing policy considerations facing decisionmakers. This challenge confronts decisionmakers in government, corporations, NGOs, and other institutions. At each level, competition for the attention of the decisionmakers increases. At the international level, the relatively weak intergovernmental institutions must rely on national authorities for actions implementing international law, and as a result, the chain reaction often requires some national catalyst in order to develop.

Lord Ashby's "chain reaction" can be elaborated and extended through a model describing "The Four Stages of Environmental Awareness."<sup>59</sup> (See the chart reproduced below).

FIGURE 1  
THE STAGES OF ENVIRONMENTAL AWARENESS



59. "The Stages of Environmental Awareness" is a model used by environmental international non-governmental organizations. This version was presented at a consultation on the draft of an Earth Charter, convened by the Earth Council (an

This paradigm is useful for evaluating whether a body of scientific knowledge has elicited an effective response from decisionmakers.

### *C. Stages of the Environmental Awareness Paradigm*

#### *1. Stage One: "Unconscious Incompetence"*

Four stages characterize the emergence of environmental issues as a priority for decisionmakers. The first stage is one of blissful ignorance, or "unconscious incompetence." In this stage, a problem may be well studied and understood by scientists, but is not yet being acted effectively upon by governments or other entities responsible for remedying the situation. Arguably, most national governments are in this stage with respect to the changes confronting Earth's natural systems. Many have established environmental protection ministries, and thus can be said to have recognized that a problem exists. These ministries, however, are weak relative to older governmental entities, and often, insufficient attention is devoted to the problems.

An ancient Russian maxim sums up this stage: "No one asks the price of water until the well runs dry."<sup>60</sup> In like vein, if levels of pollution have not yet grown to the point of demonstrably harming human health or destroying use of a resource, why should abatement be a priority demand on scarce governmental time and funding? Humans have historically assumed and relied on the bounty of the Earth. So long as the seasonal harvest yields its bounty, it rarely occurs to anyone, and particularly to political decisionmakers, to devote time to probe behind how the natural system works, or how long its yield may continue.

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international NGO based in Costa Rica) at the Rockefeller Brothers Foundation's Pocantico Conference Center (Pocantico Hills, Sleepy Hollow, N.Y.) in 1999.

60. I came across this maxim during my meetings in Russia as a participant in the U.S.A.-U.S.S.R. Joint Committee on Cooperation in the Field of Environmental Protection (1973-92). As of the spring of 2000, President Putin of the Russian Federation has abolished Russia's distinguished Forest Administration and its newer but important State Committee on the Environment (Goskomecologia), and merged them into the Ministry on Natural Resources. This is a bit like putting the fox in charge of the chicken coop and is a good illustration of Stage IV on the Model of the Four Stages of Environmental Awareness. Russia has forgotten why it needs forest stewardship and environmental protection and slips back into allowing unsustainable exploitation without regard to the problems that will probably emerge in the future again, as they have in the past. See generally N. A. Robinson & G. Waxmonsky, *U.S.A.—U.S.S.R. Agreement to Protect the Environment: 15 Years of Cooperation*, 18 ENVTL. L. 403 (1988).

In some sectors, a conscious effort has been made to support scientific knowledge in order to enhance harvests or develop more effective ways to combat pests. For instance, as an aid to ensuring sustainable yield of agricultural produce, science was encouraged to study the field, collect the relevant data, and share that data with both the scientific community and the public. Government supported agricultural schools in universities. Although some individual governmental agencies have institutionalized such scientific inquiry, it is usually only within their specific mandate. For example, the National Forest Service gathers, maintains, and assesses data on forest productivity, and the Environmental Protection Agency performs the same functions for ambient air quality.

When enough scientific knowledge has been gathered and assessed, a basis exists to sustain programs to competently manage a natural resource and to prevent recurrence of problems. Several techniques are commonly used. Either through accumulated experience or through scientific inquiry, benchmarks can be set to gauge when decisions are required to ensure that an ongoing harvest can be maintained. Benchmarks can describe the extent of the harvest that, under predictable conditions on a year-to-year basis, can be reaped without impairing the yield. Through developing and regularly using such sustainability indicators, it is possible, for example, to track the decline in reproductive capacity of a fish stock, or detect the rate of draw-down from a non-rechargeable aquifer.<sup>61</sup>

These types of scientific studies tend to address discrete sectors. Governments have found it more difficult to identify, much less support, the study of cross-sectoral or synergistic trends. Most of the changes in Earth's natural systems require analysis by multidisciplinary research. Congress recognized the need for a scientific examination of broad environmental patterns that cut across several scientific disciplines through enactment of the National Environmental Policy Act (NEPA) in 1969.<sup>62</sup> NEPA addresses three aspects of this need. First, in Section 102,<sup>63</sup> it mandates all federal agencies to develop an

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61. The draw-down of the Ogallala Aquifer under Kansas and much of the Midwest is a good example. Scientists are aware it is a finite resource, for the extraction continues and land development expands in the Midwest with no serious action to provide alternative sources of water.

62. 42 U.S.C. §§ 4321-4327 (1994).

63. Section 102 states:

The Congress authorizes and directs that, to the fullest extent possible . . . all agencies of the Federal Government shall (A) utilize a

interdisciplinary and systems-oriented analysis of the environmental aspects of each agency's programs. The intent of Section 102 is to integrate relevant scientific knowledge into governmental decisionmaking.<sup>64</sup> Second, NEPA requires that the scientific knowledge about the state of the nation's environment be gathered and re-disseminated to Congress and to the public through annual publication of the Council on Environmental Quality's Report to the President.<sup>65</sup> While these reports offer excellent syntheses of environmental trends, the shortcoming of this NEPA requirement is that there is no procedure ensuring that Congress will ever actually consider the report; historically presidents have assigned little priority to preparation of the report, which often has been submitted late and in small print numbers. Third, NEPA establishes an institution, the Council on Environmental Quality (CEQ), in the Executive Office of the President, to ensure that environmental issues will be considered by the president and by decisionmakers at the head of the federal government.<sup>66</sup> This office has had scientists on its staff, and originally included a scientist as a full Member of the Council.<sup>67</sup>

Congress originally intended the CEQ to be roughly analogous to the President's Council of Economic Advisors. A Scientist was one of its initial three members.<sup>68</sup> Thereafter,

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systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and *in decisionmaking* [emphasis added] which may have an impact on man's environment; (B) identify and develop methods and procedures . . . which will ensure that presently unquantified environmental amenities and values may be given appropriate consideration *in decisionmaking* [emphasis added] along with economic and technical considerations; (C) include in every recommendation or report on proposals for . . . major Federal actions significantly affecting the quality of the human environment . . . a detailed [environmental impact] statement.

NEPA § 102(A)-(C), 42 U.S.C. § 4332(A)-(C) (1994). Only Section 102(C) has been seriously implemented (see 40 C.F.R. pt. 1500). Sections 102(A) and (B) authorize systematic enhancements to decisionmaking that could go far toward inducing governmental agencies to cope with how human actions affect gradual and global environmental change.

64. See SERGE TAYLOR, MAKING BUREAUCRACIES THINK: THE ENVIRONMENTAL IMPACT STATEMENT STRATEGY OF ADMINISTRATIVE REFORM (1984).

65. NEPA § 201, 42 U.S.C. § 4321 (1994).

66. NEPA § 202, 42 U.S.C. § 4342 (1994).

67. For an overview of measures taken to enhance the operations of NEPA and the CEQ, see COUNCIL ON ENVTL. QUALITY, THE NATIONAL ENVIRONMENTAL POLICY ACT: A STUDY OF ITS EFFECTIVENESS AFTER 25 YEARS (1997).

68. Prof. Clark's article in this symposium notes that President William J. Clinton named no scientist or environmental engineer to his National Commission on Sustainability, a sort of blue-ribbon advisory body that was to follow-up on UNCED.

however, the Council was reduced to one member, its Chairman.<sup>69</sup> Successive White House leaders have so downgraded and under-funded CEQ that it has neglected its statutory duty to prepare a sound report for the president to transmit to the Congress and the public. The early CEQ Annual Reports were well-referenced and widely read and set the agenda for many governmental and non-governmental decisionmakers nationally. The more recent CEQ Annual Reports have been produced in small volumes, have not been timely, and have lacked adequate preparation. As a result, the annual reports have become increasingly irrelevant to government and public alike.

The CEQ did seriously attempt to assess cross-sectoral trends. A report on long-range environmental trends was prepared and was printed<sup>70</sup> toward the end of President Carter's term; the incoming administration of President Reagan recalled the report and the CEQ did not officially release the text. When the new White House staff of President Reagan came into office, they were suspicious of environmental data and the then

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It appears to have made little lasting impact on decisionmaking. President Clinton made less use of the Council on Environmental Quality than did President Bush, who enhanced it beyond the level of staffing of President Reagan. President Clinton's neglect of the CEQ, and his lack of interest in science in the realm of the National Commission on Sustainability, both suggest that reliance on well-intended political leadership is not enough. Legal standards should require such integration of the scientific view together with the political considerations. The failure of successive administrations to continue a three person Council of Environmental Quality, with scientists as members, illustrates that this is a bipartisan lacuna.

At the State level, this pattern recurs. For instance, Governor Mario Cuomo of New York named Dr. Gene Likens, a renowned ecologist, to his non-statutory Environmental Advisory Board, and because of Dr. Likens, basic state policies on soil protection and acid rain prevention were debated and advanced at the highest level, from an informed scientific perspective. Despite the strong environmental credentials of his successor, Governor George Pataki, the Executive Chamber has discontinued it, and has not appointed any Environmental Advisory Board and has no science advice in shaping New York State executive environmental policy. It is significant that neither Governors Cuomo, nor Pataki, nor Gov. Hugh Carey before them, chose to appoint the statutory Council of Environmental Advisors, a sort of state-level CEQ that was first established in the Environmental Conservation Law under Governor Nelson Rockefeller's leadership in 1972. See N.Y. ENVTL. CONSERV. LAW § 7-101, 17½, N.Y. ENVTL. LAW ch. 664 § 2 (McKinney 1972). Thus, merely authorizing the use of environmental science advice in statutes is not enough.

69. At the time this was justified on the basis that the Open Meetings law applied to the CEQ, and it was not sound to have the public attending meetings of a Council advising the President. Of course, the White House could have sought legislation exempting CEQ from this obligation, but chose not to do so.

70. See COUNCIL ON ENVTL. QUALITY, ENVIRONMENTAL TRENDS (U.S. Gov't Printing Off., July, 1981). This report anticipates the need for indicators based on ongoing data collection for environmental trends, an idea that is re-emphasized in OUR COMMON JOURNEY, *supra* note 16.

unknown implications it might hold for public policy. For more than a decade, CEQ did not return to the examination of how to evaluate intersectoral indicators of environmental quality, despite the mandate to do so in Section 102(A) and (B) of NEPA.

Moreover, CEQ's efforts to elaborate all parts of Section 102 of NEPA—other than Section 102(C)—have as yet borne no fruit; these far reaching statutory provisions remain to be implemented. In the end, all that can be concluded is that but for the statutory basis for CEQ, and its all-important role in providing guidance for NEPA's environmental impact statement process under Section 102(C), CEQ might well have been abolished. Over the years, CEQ's authority and its potential role in providing leadership to bring environmental scientific knowledge into the White House remain intact but little realized.

This approach of mandating the establishment of an entity that could examine cross-sectoral trends and present its scientific advice to decisionmakers on an annual basis has also been attempted in an international context. For example, in 1992, the United Nations Conference on Environment and Development (UNCED) recommended that the U.N. establish the U.N. Commission on Sustainable Development (U.N. CSD),<sup>71</sup> and requested that all U.N. Member States submit an annual report on the state of their environments to the commission for study. Many such national reports have been submitted and posted on a web page maintained by the United Nations.<sup>72</sup> These reports, however, have been largely ignored. Not only do governments pay little attention to these reports to the U.N. CSD, but few academics and few non-governmental organizations (NGOs) have elected to study these reports in a comprehensive fashion. The United Nations is so poorly funded by its member states that it lacks the resources to undertake such studies or to commission others to undertake them.

Even when compiled by authoritative governmental bodies, the promulgation of scientific studies by itself does not prompt decisionmakers to consider them. The ongoing process of scientific study objectively establishes what would be a basis for competent deliberation or action. By setting the knowledge foundation for determining such competence, scientific analysis becomes part of the accumulated data; however, the general

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71. U.N. Res. 47/191 (22 Dec. 1992), on report, U.N. Doc. A/47/719, requesting that the U.N. Economic and Social Council (ECOSOC) set up the Commission on Sustainable Development.

72. See <http://www.un.org/esa/sustdev/>.

public and most decisionmakers are blissfully ignorant of the existence of this essential information. This is why Stage One of the Environmental Awareness is the state of "Unconscious Incompetence."

## 2. *Stage Two: "Conscious Incompetence"*

While the second stage of environmental awareness tends to be devoid of action by decisionmakers, at least at this stage they may seek out and read scientific reports. In this second stage, decisionmakers have recognized that a problem exists, or is developing, but they are not yet prepared to act. Individuals or NGOs may worry that society should do something, but decisionmakers are not yet prepared to act. This is a phase of "conscious incompetence," in which, characteristically, governments may begin to knowingly worry and therefore commission scientific studies and inquiries.

At this stage, there are no existing systems of management or administrative procedures for addressing the problem. If any system had been established for tracking agreed-upon sustainability indicators, decisionmakers or the public could estimate which problems pose major threats and which pose minor threats. Society then might have a basis for determining which problems demand immediate action. Problems tend to fester and only a catastrophic event or an orchestrated public campaign thrusts the problem forward into the wider public consciousness that characterizes the next phase.

Lacking any system of agreed indicators or other process by which an environmental problem becomes the center of attention, a vast number of problems repose in the first phase, with few moving into the second phase. Two factors distinguish this phase of environmental awareness from the first phase: (1) there is likely to be more focused scientific study on the problems, and (2) some findings have been advanced, and the advocates for reforms have emerged. For instance, environmental NGOs are currently active in demanding new legislation and treaties to govern release of persistent organic pollutants (POPs); consequently, an international agreement on POPs will be concluded by the end of 2001.<sup>73</sup> POPs bioaccumulate in natural

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73. Under the auspices of the U.N. Environment Programme, negotiations for a convention on persistent organic pollutants were concluded in South Africa in 2000. The scientific and policy considerations leading to the convention are discussed in ANNE PLATT MCGINN, *WORLDWATCH* PAPER NO. 153, *WHY POISON OURSELVES? A PRECAUTIONARY APPROACH TO SYNTHETIC CHEMICALS* (Nov. 2000).

systems and in humans, inducing cancers. Although the release of POPs in Sweden was reduced by 75% between 1990-2000, in most other nations knowledge about POPs is limited to the medical and NGO communities, and the general public and decisionmakers are not yet motivated to demand action.<sup>74</sup> Environmentalists worry about endocrine disrupters, and the public is concerned about human exposure to pesticides and the unwanted side effects resulting from bioaccumulation of the residues. However, there is not a widespread awareness that the pesticide residues should be considered POPs, and there is little consensus for action.

While POPs are beginning to appear on the agendas of some decisionmakers, virtually none consider the comparable health problems that may be associated with a widespread pollutant, polycyclic aromatic hydrocarbons (PAHs). PAHs are residues from the combustion of petroleum products in motor vehicles. The same public that is in blissful ignorance of the PAH problem (Stage One), is worried about the residues of pesticides (Stage Two), but not yet to the point where the appropriate solution for providing protection to the public from POPs is in hand.

Unless society can find a way to more rapidly move issues through this second stage, the problems will continue to fester and may well become more difficult or costly to contain as time passes. Internationally, many of the environmental degradation trends grow more acute through the impacts of the continuing expansion of Earth's human population. Moreover, each discrete trend becomes worse as it intersects with other trends. It becomes increasingly problematic to resolve each of the competing sustainability issues.

### *3. Stage Three: "Conscious Competence" in Addressing Scientifically Defined Problems*

At the third stage of environmental awareness, a chain reaction has started the process of competently searching for, identifying, and implementing solutions to environmental problems. The process of seeking and refining a solution can

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74. In Sweden, decisionmakers and the public became alarmed about POPs, and in 1990 they decided to reduce the use of all pesticides in Swedish agricultural and industrial uses by 50%, in order to reduce the exposure to humans by the residues. Sweden reached the 50% reduction level by 1996, and then decided to reduce uses by another 25%. By the year 2000, Sweden had stabilized its pesticides uses at only 25% of what was being used in 1990. Swedish decisionmakers understood the science and took action. The Swedish Chemicals Inspectorate is the agency responsible for maintaining this Stage Four of environmental awareness.



take years, but at least the society is engaged in working on the problem. Implementation of reforms often can result in controversy and mistakes; meanwhile there is a general need to re-educate all involved. Problems are rarely resolved until a more or less efficient governance system has emerged that is considered appropriate for resolving the problem. Even with a system of governance for resolving problems, some persons will not accept the solutions. Opponents of reforms seize on the initial awkwardness or mistakes to oppose adoption of proposed reforms, or to advocate the repeal or rejection of reforms.

Stage Three is characterized by conscious competence. At this stage, decisionmakers act upon and seek out scientific research, giving it serious consideration in decisionmaking. Governments seek to institutionalize procedures for the establishment of scientific standards, the collection of data under an agreed methodology, the evaluation of the data using established protocols, and the timely consideration of the resultant reports in the decisionmaking process.

It can take substantial time for reforms launched in Stage Three to become fully established. For instance, scientists have known lead to be a poison for centuries.<sup>75</sup> Nonetheless, when lead was added to gasoline as an anti-knock device, there was no general knowledge that lead in the exhausts from combustion of the leaded gasoline could become a widespread health hazard. Only when empirical studies demonstrated that emissions were harming people, especially children, were there calls to ban lead in gasoline. When, as a result of the 1970 Clean Air Act,<sup>76</sup> the U.S. Environmental Protection Agency effectively mandated the use of the catalytic converter to reduce automotive air pollution, it became necessary to eliminate lead in gasoline because the lead would disable the catalytic converter. Thus, it became possible to ban the use of lead in the early 1970s. It then required a decade to phase lead out of use, with a final prohibition on the production of engines requiring leaded gasoline by 1990.<sup>77</sup> Ambient air quality assessments showed a rapid decline in levels of lead, and human body levels of lead also declined. In Western Europe, the European Union banned lead around 1980, and it has taken over a decade to eliminate the lead from gasoline in Western Europe. Meanwhile, in Russia,

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75. S. Hernberg, *Lead Poisoning in an Historical Perspective*, 38 AM. J. IND. MED. 244, 244-54 (2000).

76. See Clean Air Act Amendments of 1970, Pub. L. No. 91-604, 104 Stat. 2399, 42 U.S.C. §§ 7651-7651o.

77. See 42 U.S.C. § 7553 (1994).

much of Central Europe, Thailand, China, and elsewhere, lead is only now being eliminated. The world will have taken over 75 years (two human generations) to achieve the goal of eradicating the use of lead in gasoline.

This stage of "conscious competence" requires establishment of procedures that can sustain reforms over such long periods of time. The U.S. experience with abatement of water pollution provides a useful example. Throughout the period between the First World War and the post-Second World War, industrial wastes were, with abandon, dumped into the surface waters of the United States. As a result, the water quality deteriorated. The rather weak Federal Water Pollution Control Act<sup>78</sup> (FWPCA) sought to encourage the states to establish water quality standards (which might now be considered sustainability indicators) and to curb pollution that degraded the water quality. When this process of deference to the states failed to produce action to curb water pollution, Congress enacted the 1972 FWPCA Amendments.<sup>79</sup> Congress further strengthened water regulation in 1977 when the legislation was symbolically renamed the "Clean Water Act" (CWA).<sup>80</sup>

This legislative system for abating water pollution in the United States relies heavily on an institutionalized scientific process. The states are required to classify all surface waters within their boundaries.<sup>81</sup> The methodology for water quality classifications is standardized nationally.<sup>82</sup> Every seven years, the CWA obliges states to re-examine the classifications and ascertain if water bodies can be reclassified at levels having fewer pollutants. The surface water quality is to become cleaner through a system of increasingly effective controls on effluents. Every discharge point into waters is required to have a permit, and the Environmental Protection Agency has established engineering standards for each industrial sector determining the process for effluent treatment that is required for that sector.<sup>83</sup> These permits must be periodically renewed, no less frequently

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78. See Federal Water Pollution Control Act, June 30, 1948, ch. 758; 62 Stat. 1155, incorporated in 33 U.S.C. §§ 1251-1387 For a treatment of the evolution of these water pollution laws, see also FRANK GRAD, *TREATISE ON ENVIRONMENTAL LAW* (1999).

79. See Federal Water Pollution Control Act Amendments of 1972, Pub. L. No. 92-500, incorporated in 33 U.S.C. §§ 1251-1387.

80. See Federal Water Pollution Control Act Amendments of 1977, Pub. L. No. 95-217.

81. See Clean Water Act § 304, 33 U.S.C. § 1313 (1994).

82. See ENVIL. PROT. AGENCY, *QUALITY CRITERIA FOR WATER* (1986).

83. See Clean Water Act § 402, 33 U.S.C. § 1342 (1994).

than every five years, with reference to any engineering improvements in effluent limitations. The discharge permits are to provide effluent limitations stricter than those produced by use of the engineering standards whenever necessary to assure that the receiving water quality standards will not deteriorate. Moreover, each effluent source must maintain discharge monitoring reports to demonstrate compliance with permit conditions, and these reports are open to public inspection. If the U.S. Environmental Protection Agency, or a state, or a permittee fails to adhere to these procedures, any person is authorized to enforce them through a citizen suit,<sup>84</sup> which is an enforcement procedure in addition to the government's normal administrative, civil, or criminal enforcement systems.

Management of deliberate discharges into surface waters has evolved from a process of continuous gradual reform into a professional, even routine process. It is a system of complementary and mutually reinforcing measures merging the science of water quality, the technology of the dischargers and the decisions about water pollution abatement. Under the CWA, scientific findings often determine the outcome of environmental decisionmaking. As a result, the surface waters of the United States today are much closer to the statutory goal of "fishable and swimmable" quality<sup>85</sup> than was the case in 1972 when the system was established. It took over fifty years to build this institution of science-based water quality management.

The time frame for attaining a level of competence in Stage Three may be longer where resources for scientific analysis are scarce. For instance, in India, in cases brought by the public interest advocate M.C. Mehta and others, the Supreme Court has ordered that the water quality in the River Ganges and in other waters be restored.<sup>86</sup> Since India's Pollution Control Boards in the states often lack the capacity to accomplish the task, the Supreme Court has used injunctions to close factories. Nonetheless, water pollution remains a serious problem, and India lacks a systematic process to abate pollution. In China, the State Environmental Protection Agency (SEPA), in 1998-99, peremptorily and permanently closed over 60,000 small factories that were grossly polluting and wasting resources. The levels of pollution had become so gross as to trigger responses typical of

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84. *Id.* § 505, 33 U.S.C. § 1365 (1994).

85. *Id.* § 101, 33 U.S.C. § 1251 (1994).

86. *See* M. C. Mehta v. Union of India, A.I.R. 1988 S.C. 1037; M. C. Mehta v. Union of India, A.I.R. 1991 S.C. 1332.

Stage Three.<sup>87</sup> China, however, lacks the trained personnel to ensure that other factories are moving rapidly to abate ongoing pollution.<sup>88</sup> It is evident that building up the capacity for environmental competence is a critical foundation for advancing through Stage Three.

Very few of the global environmental problems are being managed at Stage Three. The Vienna Convention for the Protection of the [Stratospheric] Ozone Level,<sup>89</sup> together with the Montreal Protocol on Substances That Deplete the Ozone Layer,<sup>90</sup> and the subsequent related agreements and protocols,<sup>91</sup> are perhaps the best illustrations of building that sort of systematic process to abate an environmental threat that characterizes Phase Three. The nations of the world have made the decision to phase out the manufacture and use of most of the gases that deplete stratospheric ozone. Despite the success that has characterized ozone reduction, most of Australia, Argentina, Chile, and much of South Africa have experienced total loss of the stratospheric ozone layer's protection against solar ultraviolet radiation (UV-B radiation).<sup>92</sup> It will take over a decade for the chlorofluorocarbons already released before 1990 to reach the stratosphere, so it cannot be known for some time whether the stratospheric ozone shield can be restored.<sup>93</sup> The process of reclaiming extant CFCs still in use is awkward and inadequate. Nonetheless, the work to solve the problem is well underway, and is founded upon accepted scientific studies. Governments and industry alike have made the commitment to invest in further scientific study. At both the international and national levels there is an institutionalized system for considering scientific findings.

The same cannot be said for most of the other global environmental concerns. For instance, "acid rain" has been on the international agenda ever since the United Nations'

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87. See Patrick E. Tyler, *A Tide of Pollution Threatening China's Prosperity*, N.Y. TIMES, Sept. 25, 1994, at A3.

88. See generally William P. Alford & Yuanyuan Shen, *Limits of the Law in Addressing China's Environmental Dilemma*, 16 STAN. ENVTL. L.J. 125 (1997).

89. See generally Convention for the Protection of the Ozone Layer, Mar. 22, 1985, 26 I.L.M. 1529 [hereinafter Vienna Convention].

90. See generally Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, art. 9(2), 26 I.L.M. 1541 [hereinafter Montreal Protocol].

91. Adopted at London at the Second Meeting of Parties to the Montreal Protocol, 29 June 1990, U.N. Doc. UNEP/Oz.L.Pro.2/3 (Annex II).

92. Cynthia Pollock Shea, *Protecting the Ozone Layer*, in STATE OF THE WORLD 77-96 (Lester R. Brown et al. eds., 1989).

93. Hilary F. French, *Ozone Response Accelerates*, in VITAL SIGNS 102-03 (Linda Starke ed., 1997).

Stockholm Conference on the Human Environment in 1972 when Sweden documented the acidification of its lakes and forests from pollutants emitted in the United Kingdom and in the Rhur basin by Germany and France. The issue became an international law problem for decisionmakers. After seven years of negotiation through the United Nations Economic Commission for Europe, the nations produced the Geneva Convention on Long-Range Transboundary Air Pollution in 1979.<sup>94</sup> The Protocols implementing this Convention integrate scientific standards and data collection into a process of emission abatement for major stationary sources of air contamination that resembles the process of the U.S. Clean Air Act.<sup>95</sup> Meanwhile, concern over acid rain in the United States reached a political peak through the 1980s because the administration of President Ronald Reagan refused to take action on what the scientific community had persuaded the public was a serious problem. President George Bush acknowledged the problem, and Congress took action with the 1990 Clean Air Act Amendments.<sup>96</sup>

Just because an environmental problem reaches Stage Three does not mean that environmental awareness will be sustained to ensure remedial actions by decisionmakers continue. Actions to resolve acid rain have not sustained abatement of the pollutants that cause acid rain; reforms have stalled in the United States and Europe. Once Congress enacted the 1990 Clean Air Act Amendments, decisionmakers and the public set aside their interest in the issue. The acid rain controls under the 1990 amendments to the Clean Air Act<sup>97</sup> did curb some of the growth in the volume of acid precipitation, but they have not eliminated the ongoing phenomenon in Canada and the United States. Further scientific information about acid rain does not reach decisionmakers and the news media ignore it. Any effort, under the 1990 Clean Air Act Amendments, to advance additional reforms to abate acid rain further have become uncoupled from decisionmaking for other reasons as well. When emission trading

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94. See generally Convention on Long-Range Transboundary Air Pollution, Nov. 13, 1979, T.I.A.S. 10541, 1302 U.N.T.S. 217, 18 I.L.M. 1442 [hereinafter Geneva Convention].

95. See generally Protocol Concerning the Control of Emissions of Nitrogen Oxides or Their Transboundary Fluxes, Oct. 31, 1988, 28 I.L.M. 212. The U.S. Environmental Protection Agency provided much of the methodology and scientific process for this Protocol, drawing on the EPA's experience under the Clean Air Act.

96. See Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2399, 42 U.S.C. § 7651.

97. See Subchapter IV-A, *Acid Deposition Control*, 42 U.S.C. §§ 7651-7661f, added in Pub. L. 101-549, Title IV, 104 Stat. 2584.

was established, the effect of the trading was to stabilize emission levels, not to require their further abatement.<sup>98</sup> Companies owning electricity-generating facilities in the Midwest now have vested interests in resisting renewed efforts to abate the pollution emissions that result in acid rain. A similar decline in awareness has appeared in Western Europe, where integration of the scientific evidence with decisionmaking has effectively been relegated to technical and administrative levels and has been delegated away from senior environmental decisionmakers. The data collection and scientific research are not tied to effective control mechanisms because the authority to establish controls remains with the separate nations in Europe.

Thus, in Stage Three where only some components of an effective or complete *system* or procedure to cope with the problem are in place, progress can stall. Rather than rely on scientific study as a basis to trigger still more stringent action to abate the problem (analogous to the process of enhancing water quality under the Clean Water Act), the Clean Air Act's technical processes for coping with acid rain are no longer linked to political decisionmaking. Volumes of acid rain increase around the world, but decisionmakers and the public currently ignore this phenomenon.<sup>99</sup> The problem of acid rain may have entered Stage Three in Europe with the Geneva Convention, and in the United States with the 1990 Clean Air Act Amendments, but lacking a process to continue these advances, decisionmakers' awareness of the problem is lapsing back toward Stage Two. This has had a further dampening effect on any further governmental or intergovernmental measures to abate acid rain; once decisionmakers in North America and Western Europe appeared to be no longer troubled by acid rain, decisionmakers in other regions expressed no sustained interest in addressing acid rain.<sup>100</sup> Any priority once given to this issue has been displaced

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98. See Isabel Rauch, *Developing a German and International Emissions Trading System—Lessons from U.S. Experiences with the Acid Rain Program*, 11 FORDHAM ENVTL. L.J. 307 (Spring 2000).

99. Since the enactment of the 1990 amendments to the Clean Air Act, which contained some measures intended to further abate acid rain, the news media rarely report about the problem. Because the detrimental effects of acidic precipitation are not immediately evident in many places, most of the public assumes that the 1990 Clean Air Act has solved the acid rain problem. Smug satisfaction has caused the reforms to slip back toward Stages One or Two. Society is ignoring the ongoing scientific study about acid rain demonstrating that the problem persists.

100. In Asia, where acid rain is an acute problem, there are neither international nor national systems to eliminate acid rain. Similar conditions exist in South America and Africa where the problem is just emerging. Although acid rain has been a significant issue in Western Europe and North America for four decades, and may

for the time being. Problems of acid precipitation await some further catalyst to launch the chain reaction that can move decisionmakers to eliminate more of the emissions causing acid rain.

Where Stage Three reforms work well, therefore, decisionmakers need a procedure in some law or regulation that sustains their focus on the scientific reports or indicators about the specific environmental problem. Where the process works well, it can become so well accepted and institutionalized that it moves into an accepted environmental awareness in Stage Four.

#### *4. Stage Four: "Unconscious Competence" and the Slide to Unconscious Incompetence*

In the fourth stage of environmental awareness, an environmental problem is handled competently, and the public and decisionmakers assume that the problem is resolved or is being managed sustainably. The underlying problem usually requires some level of ongoing attention and, therefore, the systems in place to manage the problem must be sustained. At this stage it is important for scientists and decisionmakers to have agreed upon indicators designed to alert decisionmakers to situations where the old solutions unravel and the problems re-emerge. For instance, the effectiveness of pollution controls depends on routine sampling for specified pollutants; the annual limits for fishing or hunting depends on measuring the reproductive yield of the species; remote sensing by satellite can measure increases or decreases in forest cover and facilitates estimates about biodiversity or carbon sequestration capacity in the forest under study. Unfortunately, few such indicators exist.

There are few established indicators for evaluating the success of providing potable water to urban areas. The successful provision of potable water to the 13 million people in the greater New York City metropolitan area offers an example of what can go wrong in environmental decisionmaking. In the mid-nineteenth century, New York had contaminated its aquifers with the waste from privies. After establishing remote reservoirs and an elaborate aqueduct system, New York City residents had come to assume that they would always have potable water; the city did not meter the use of water and imposed modest fees for the supply of water. Although the city had expanded its remote

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be deemed to have entered Stage Three in those two regions, the problem of acid rain is at Stage One or Two in most of the world.

water reservoirs prior to World War II, it subsequently experienced rapid expansion of new building; growth outpaced available water supplies. At the same time, new real estate development in the reservoir watershed occurred without regard for protecting water quality from run-off. Pollution emerged in the reservoirs. As a result, New York City today lacks an adequate volume of water to meet current demand under drought conditions and cannot ensure potable water quality.<sup>101</sup> The Environmental Protection Agency is requiring the city to invest approximately six billion dollars in a water filtration plant. In addition, the city's reservoir management is under scrutiny and New York State intervened to mediate agreement between the City of New York and local governments controlling land use decisions around the reservoirs. Lacking a systemic process to ensure that water supply and quality were sustained as a priority among the city's decisionmakers, the city slipped from a century of competent management at Stage Four unconscious competence back to the incompetence of Stage One.

The Fourth Stage is one of reasonable success in coping with an environmental problem. Society can internalize the costs of solutions and cope with a problem. For example, many companies, especially multinational companies in the manufacturing sector such as the pharmaceutical companies, have established effective management systems for waste minimization and "eco-efficiency."<sup>102</sup> These management systems attain cost-savings, avert or avoid liabilities, and achieve social benefits for the companies that successfully employ them. Some of these corporate environmental, health and safety (EHS) programs or environmental management systems (EMS), have become so routine and effective that a number of companies' environmental managers now complain that their boards of directors take them for granted. Unless the corporate management systems can keep environmental issues before the boards of directors, even good corporate EHS or EMS can unravel and slide back to levels of unconscious incompetence.

Whether it is a municipal water supply, a corporate EHS program, or a national regulatory program, the same mistaken sense can develop that "the problem is solved, so why do we need to spend money on the problem?" There is a need to

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101. For a critique of New York City's shortcomings in the Report of the Reservoir Keeper, see Robert F. Kennedy, Jr., *A Culture of Mismanagement: Environmental Protection and Enforcement at the New York City Department of Environmental Protection*, 15 PACE ENVTL. L. REV. 223 (1997).

102. See STEPHAN SCHMIDHEINY, *ECO-EFFICIENCY* (1992).



communicate periodically with decisionmakers about how a problem is being contained and what levels of support are needed to sustain competent management. Systems must oblige decisionmakers to exercise due diligence to consider such reports and certify that the problems are being managed adequately. The system of due diligence inspections as a part of real estate purchase and sale transactions ensures that a site has no unknown hazardous chemical contamination; this system is the result of the federal Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).<sup>103</sup>

When such systematic reviews fail, effective programs can be sacrificed. For instance, when former Speaker Newt Gingrich proposed his "Contract with America,"<sup>104</sup> some of the members of Congress targeted the Clean Water Act for repeal on the grounds that its regulations were no longer needed. After all, they reasoned, if the nation's waters were clean, why continue regulations so evidently unnecessary? In response, an unlikely alliance of bass fishermen, environmental lawyers, corporate EHS managers, professional governmental environmental managers, and environmental NGOs coalesced to beat back a strong political effort to repeal the Clean Water Act. Enough of the public understood the science, their stake in the natural resource, and why the legal system was essential to maintaining surface water quality to ensure the survival of the CWA.

The weakness in this fourth stage of unconscious competence is that its very success can induce the public and officials to take success for granted. The problem is forgotten, along with how to cope with it. Legal procedures provide an assurance that the management systems can be sustained and not neglected.

### III

#### SCIENCE IN THE STAGES OF ENVIRONMENTAL AWARENESS

Scientific inquiry and analysis, of course, is ongoing during each of these four stages of environmental awareness. This continuing development of scientific knowledge alone, however, is not enough to catalyze the chain reaction that produces reforms. Understanding Earth's environmental problems through the narrow view of "sustainability science" will not be sufficient to trigger the chain reaction that prompts decisionmakers to

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103. See Comprehensive Environmental Response, Compensation, and Liability Act § 107, 42 U.S.C. § 9607 (1994).

104. CONTRACT WITH AMERICA (Newt Gingrich & Bob Schellhas eds., 1994).

work on resolving those problems. The essential importance and the limitations of scientific knowledge can be examined by applying the model of these four stages of environmental awareness to two global problems: (1) depletion of the stratospheric ozone layer and (2) loss of biodiversity.

#### A. *Protecting the Stratospheric Ozone Layer*

The paradigm of the four stages of environmental awareness can provide insight into measures that may be fashioned to institutionalize consideration of science in relevant governmental or other decisionmaking. The process of ozone regulation provides a clear example.<sup>105</sup> When Professor Rowland, and others, posited the theory that chlorofluorocarbons (CFCs) might be eroding the ozone layer in the stratosphere, industrial spokesmen belittled and attacked the hypothesis.<sup>106</sup> Scientists, however, took it seriously. In a series of scientific seminars under the auspices of the U.N. Environment Programme and others, scientists met with diplomats together to study the problem. As a result, the diplomats became sufficiently concerned to agree to negotiate the 1985 Vienna Convention on the Protection of the Ozone Layer.<sup>107</sup>

As an international agreement, the stratospheric ozone treaty appears to be rather weak. In essence, it merely obligates member states to cooperate in scientifically examining the status of the stratospheric ozone and taking any action that the parties may decide is appropriate. The states that are parties to the Convention agree to "take all appropriate measures . . . to protect human health and the environment against adverse effects resulting from or likely to result from human activities which modify or are like to modify the ozone layer."<sup>108</sup> Although the stratospheric ozone is a matter of common concern to all nations, the Convention is silent on this legal point, assuming that the self-interest of all states in maintaining Earth's

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105. F. Sherwood Rowland, *Atmospheric Changes Caused by Human Activities: From Science to Regulation*, 27 *ECOLOGY L.Q.* 1261 (2001).

106. See DOTTO & SCHIFF, *supra* note 36, at 153 (quoting Robert Abplanalp, President of Precision Valve Corporation, who wrote in *Harper's Weekly* magazine that the science was inadequate and that the media reporting the scientists' findings "merely wrote what they were told and perhaps, as witlessly as Henny Penny, proceeded to inform everyone that the sky was falling.").

107. See generally Vienna Convention, *supra* note 89.

108. *Id.* art. 2(1).

stratospheric ozone layer is a basis for cooperating.<sup>109</sup> The treaty obligates the ratifying states to undertake, as appropriate, scientific research, systematic observations and assessments, and the exchange of scientific and technical knowledge. The Convention integrates scientific analysis into virtually all of its decisionmaking. The negotiation of the treaty, while of substantial significance in international law, was not popularly understood. When concluded, the treaty itself immediately affected no industrial or commercial activity.

Scientific theory had launched a treaty, but science alone was not the catalyst for spurring nations into action. Before the required minimum of twenty states could ratify the treaty to make duties to cooperate a legal requirement, British scientists had discovered the "hole" in the ozone above Antarctica. This discovery confirmed Dr. Rowland's theory, and the parties to the Vienna Convention redoubled their voluntary scientific inquiries. The "hole" discovered in the stratospheric ozone layer was a new kind of global threat that alarmed the public and decisionmakers; "freon," as chlorofluorocarbons were called commercially, could endanger one of Earth's basic natural systems. The urgent need for further study and action was evident, and nations contributed to such scientific analysis.<sup>110</sup> When the Parties met to negotiate the Montreal Protocol in 1987, the Vienna Convention was still not in force. Nonetheless, the parties agreed to a 50% reduction in CFC use.<sup>111</sup> The London Agreement in 1990 effected a ninety-percent reduction in the volume of manufacture and use of CFCs and other substances that deplete the ozone layer.

Even the scientific consensus and diplomatic agreement at Montreal, however, were not sufficient for the decisionmaking at the diplomatic conference. Additional catalytic agents beyond scientific knowledge were required. In this case, it was the procedures established by Congress for the appointment of an Administrator for the Environmental Protection Agency. The EPA Administrator in office was Lee Thomas, who had studied the

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109. While some 150 nations have ratified the UNFCCC, only some 90 have ratified the Vienna Ozone Convention and some 70 the Montreal Protocol. This is a measure of how seriously decisionmakers in different states regard the chemistry and physics of stratospheric ozone layer and either their stake in its protection or their capacity to act to protect it. The foreign policy decisionmakers in roughly half the states have not chosen to move beyond Environmental Awareness Stages One or Two, and into Stage Three.

110. See RICHARD E. BENEDICK, *OZONE DIPLOMACY* (1991).

111. See Vienna Convention, *supra* note 89, art. 4(2)(d).

scientific knowledge about the CFCs and the ozone layer and was convinced that action was required. Throughout the Montreal negotiations, the White House under President Reagan had opposed the 50% reduction in CFCs. In order to win the United States over to the goal agreed to in Montreal, it took the quiet but real threat of resignation by Thomas, President Reagan's own EPA Administrator, to secure the Reagan administration's support for the Montreal Protocol. Reagan had lost two previous EPA Administrators: Ann Gorsuch, who resigned following public controversy, and William Ruckelshaus, who had returned to restore the public's confidence in the EPA and then quietly stepped down because the White House was unwilling to support his recommendations to undertake further measures toward curbing acid rain. Thomas put his job on the line to support the scientific and diplomatic consensus, and the Reagan White House believed that it politically should not go through the Congressional and public scrutiny of naming yet a fourth EPA Administrator. Thus, while science may have been the fundamental basis for environmental decisionmaking, science alone might not persuade decisionmakers in the United States to sign onto the Montreal Protocol. Some procedures must exist to ensure that decisionmakers cannot avoid acting on the scientific knowledge.

The catalyst in the case of the CFCs was the dramatic scientific discovery of the ozone hole, and the chain reaction successfully took hold because there was already a procedural forum in the conference of the parties to the Vienna Convention, which in turn was linked to domestic governmental procedures in which that scientific knowledge could not be ignored. The joint scientific/diplomatic seminars that led to the negotiation of a "weak" treaty allowed the international community of states to quickly start to remedy the problem. The seminars had pushed the possible threat to the stratospheric ozone issue from Stage One to Stage Two rather quickly, leading to the negotiation of the Vienna Ozone Convention in 1985. Although the Convention was not in force, its recent negotiation made it easier to reconvene diplomatic delegations to negotiate the Montreal Protocol in 1987. The crucial U.S. signature and subsequent Congressional acceptance of the Montreal Protocol was linked to the duties and appointment process for the EPA Administrator. The consensus in Montreal facilitated the commission of further scientific research and analysis, which in turn led to the London Agreement and subsequent refinements in this treaty system. A decade later, the environmental awareness of the participating

nations involved has reached the third stage of environmental awareness. Actions are being taken with some urgency to reduce CFC use, phase out the last manufacturing facilities, prohibit releases of CFCs into the atmosphere, and pursue black-marketers in CFCs with criminal sanctions.<sup>112</sup>

### *B. International Conservation*

The model of the four stages of environmental awareness can also be applied to the international efforts to conserve nature and prevent extinction in species. Conservationists had seen the need to maintain sustained yields of wild animals since the late nineteenth century. In the first part of the twentieth century, Congress created the U.S. Fish & Wildlife Service and established the system of national game and wildlife refuges.<sup>113</sup> In the 1920s, some wildlife agencies concluded that international cooperation was required for nations to protect migrating species and share experiences in conservation management. The Second World War interrupted the international endeavors to build an international network, but in 1947, U.S. and European wildlife agencies, conservation scientists, and civic leaders persuaded the U.N. Educational, Scientific, and Cultural Organization to recommend that a new organization be established. The Republic of France agreed to convene a diplomatic conference, and in 1948 the "International Union for the Protection of Nature and Natural Resources" was established.<sup>114</sup> The new international organization was an unusual coalition of sovereign states, government ministries in charge of fish and game and forests, scientific societies, and conservation NGOs.<sup>115</sup>

This unique group has continued for more than 50 years. The members replaced the word "protection" in the title with "conservation" after a debate that recognized that sustainable use and sustained yield are more realistic goals than is total preservation. The IUCN membership<sup>116</sup> now includes seventy-six

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112. See Clean Air Act Amendments of 1990, Pub. L. No. 101-549, 104 Stat. 2568, 42 U.S.C. §§ 7671- 7671q.

113. For the Fish and Wildlife Service's history of the refuges, see <http://refuges.fws.gov/history/index.html>.

114. See MARTIN HOLDGATE, *THE GREEN WEB* (1999). Sir Martin is a former Director General of IUCN and prepared this history for IUCN's fiftieth anniversary.

115. *Id.*

116. Current membership figures are available on the IUCN web site, <http://www.iucn.org/2000/about/content/memberstate.html>.

states that adhere to IUCN's statutes as a treaty obligation,<sup>117</sup> over a hundred governmental agencies, and over five hundred international and national NGO members that associate with it under Swiss law. IUCN also has six expert commissions, including the Species Survival Committee. The Species Survival Committee is comprised of 12,000 scientists around the world who collect data on individual species and document threats of extinction in the many IUCN "Red Data Books."<sup>118</sup> For fifty years, IUCN's World Commission on Protected Areas has been the international forum for the managers of national parks systems worldwide. IUCN convenes a World Parks Congress once each decade.

Most of IUCN's extensive work has attracted little attention, and despite operations in 139 nations, IUCN is not well known.<sup>119</sup> IUCN functions largely within the environmental awareness of Stages One or Two. At the national level, parks and wildlife refuges and laws of nature conservation are effective and may be deemed to have sufficient support to be stabilized within some geographic locations at Stage Three; indeed, if all the protected areas were gathered in one place they would collectively cover more than the Indian subcontinent.

Despite the increasing amounts of flora, fauna, habitat, and lands that are preserved in parks, IUCN has found that the rate of species extinction is increasing. IUCN decided to address the problem of the extinction of species by focusing on one of the root causes for extinction, the trade in endangered species. The threat of extinction is not simply a national issue, caused inadvertently by regional land use patterns such as habitat loss through conversion to new agricultural uses, or clear-cutting forests. After the Second World War, a lucrative international trade in endangered species and their parts had given rise to poaching and an accelerated process of targeting "valuable" species for exploitation. IUCN's Species Survival Commission could document which species were threatened, but lacked the power to halt this lucrative commercial trade. In response to this dilemma, IUCN's Commission on Environmental Law prepared a proposal to fashion a procedure to respond to the scientific knowledge gathered by the Species Survival Commission.

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117. IUCN's Statute is reproduced on the IUCN web site, <http://www.iucn.org/2000/about/content/memberstate.html>.

118. See 2000 IUCN RED LIST OF THREATENED SPECIES (Craig Hilton-Taylor ed., 2000).

119. For instance, IUCN was instrumental in establishing the World Wildlife Fund (WWF), which has become far better known popularly than its progenitor.

In 1970, the Chairman of the IUCN Commission on Environment, Dr. Wolfgang E. Burhenne, proposed a treaty to IUCN's members, and with the members' endorsement, then invited the U.S. State Department to host a diplomatic conference. In 1973, IUCN cooperated with the United States and other states to negotiate the Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES).<sup>120</sup> Under CITES, when analysis of scientific data indicates that a species is threatened with extinction, the parties formally make a decision to add that species to the lists of protected species, for which trade is not allowed. IUCN's Species Survival Commission continues to provide scientific data about species to the Conference of the Parties of CITES. CITES decisions are implemented by national customs agencies all around the world. Violations of a ban in trade of a given species results in criminal investigation and prosecution under environmental laws in the United States and other states.

In a system sustained now for several decades, IUCN has both generated scientific knowledge and ensured that this knowledge is considered in the decisionmaking process. IUCN's scientists continue to collect and compile relevant data in a form readily disseminated through the IUCN Red Data Books. IUCN's legal experts provide legal advice for drafting national legislation to implement CITES and further conservation of nature. The United States and other nations have enacted national endangered species legislation,<sup>121</sup> which protects threatened species from inadvertent or deliberate takings and reinforces the obligations embodied in CITES. In the United States, the Endangered Species Act also identifies and preserves critical habitat for threatened species.

Despite CITES, national legislation and growing numbers of national parks or other protected areas, the scientific community continues to document the loss of biological diversity worldwide. IUCN was not content to address species loss through the narrow sector of trade; thus IUCN began collecting scientific and legal resources to address biodiversity more comprehensively. In 1988, at the IUCN General Assembly of its Members held in Costa Rica, IUCN's Commission on Environmental Law presented the first of a proposed "Convention on Biological Diversity." IUCN recognized that a more proactive and systematic process was needed. Although the IUCN membership was

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120. See CITES, *supra* note 31.

121. See generally Endangered Species Act, 16 U.S.C. §§ 1531-1544 (1994).

unsure if an abstract concept such as "biological diversity" could be made politically acceptable, the members endorsed efforts for the preparation of such an international agreement.

IUCN's Commission on Environmental Law then introduced the proposal to both the U.N. Food and Agricultural Organization (FAO) and the U.N. Environment Programme (UNEP). Through the U.N. General Assembly, the states assigned UNEP the task of forming an International Negotiating Committee to prepare the proposed Convention on Biological Diversity. IUCN's legal experts participated in the negotiations, which paralleled both the negotiations for the drafting of the U.N. Conference on Environment and Development and for negotiating the U.N. Convention on Climate Change. The final Convention on Biological Diversity (CBD) was ready to open for signature at UNCED in Rio de Janeiro in 1992.

IUCN had been able to give a legal definition to the scientific concept of "biological diversity" through its study draft of a proposed treaty on the subject of conserving biodiversity under international public law. By focusing on the need for a forum and procedures through which decisionmakers would have to confront scientific knowledge about biodiversity, IUCN managed to move the issue from Stage One or Two into Stage Three of environmental awareness. The timing was important, since a catalyst existed in the timetable leading to the U.N. Conference on Environment and Development in 1992. By linking the scientific knowledge about biodiversity loss (which had been known to scientists for decades) to the momentum for the U.N.'s "Earth Summit," IUCN both reached the decisionmakers in the international diplomatic community and achieved an accelerated negotiation of a treaty to establish a process for conserving biodiversity. The work to leverage biodiversity into Stage Three took less than a decade, which was faster than the CITES effort. Since the CBD has come into force, it has fundamentally altered national and international decisionmaking processes regarding the world's biological resources. IUCN has sent scientific delegations to the Conferences of the Parties of the CBD and actively participates in their decisionmaking. For example, Colombia's Minister of the Environment, Juan Mayr, a member of IUCN's governing council, led the successful negotiations for the Biosafety Protocol to the CBD in 1999. Much work remains to be done to conserve biodiversity, such as the enactment of national implementing legislation, but the process is underway and science is inextricably integrated into this decisionmaking.



As illustrated by these progressive developments of international law to protect the ozone layer and to safeguard biological diversity, using the paradigm of the four stages of environmental awareness can facilitate an understanding of the relationship between scientific inquiry and analysis and the decisionmaking processes of governmental authorities. One can gauge whether or not decisionmakers are likely to consider scientific analysis by estimating whether the awareness of a given environmental problem is at Stages One, Two, or Three. It is unlikely that society will provide adequate funding for scientific inquiry until the public and political awareness of the issues are well-developed in Stage Two or have reached Stage Three. Those who want decisionmakers to address a given environmental problem need to design strategies that build the needed environmental awareness and not assume that the presentation of the scientific findings alone will result in an adequate response by authorities.

What then, are the questions that such a strategic approach should consider? Given the utility of the environmental awareness paradigm to gauge whether an issue has politically matured to the point where decisionmakers are receptive to action, the question becomes what procedures might be designed to move a problem over the threshold from Stage Two to Stage Three? What catalysts can be identified that build a chain reaction toward decisions? Can legal or institutional methods be established to facilitate transitions between Stages Two and Three so that decisionmakers will necessarily consider scientific information? Equally important, can such procedures maintain a Stage Four level of conscious competence and not permit a slip back to the first stage of unconscious incompetence through the neglect of the scientific information? The field of Environmental Law provides useful specific and tested models of legal procedures that can integrate scientific knowledge into environmental decisionmaking.

#### IV

##### LAW AND INSTITUTIONS: INTEGRATING SCIENCE WITH DECISIONMAKING

Environmental Law has been a principal medium through which governmental systems have integrated the environmental sciences into political decisionmaking. The environmental sciences provide descriptions and models of nature's functions, methods for analyzing human impacts on those systems, and an ongoing reassessment and refinement of those natural systems.

The procedural dimension of environmental law has been to ensure that this scientific analysis is relied upon in decisions about humans and nature. These procedures couple scientific evaluation with the decisionmaker's essential normative judgment to address specific problems in context: how, in light of competing economic and social factors, and in view of alternative possible technologies, should ongoing or proposed human conduct be modified in order to protect the public health and to restore and maintain the integrity of natural systems?

In terms of the paradigm for the Stages of Environmental Awareness, if the environmental legal procedures are to be effective, they should address the following elements: (1) to nurture and sustain scientific research to identify and define problems during Stage One; (2) to provide further scientific analysis and also strategic measures, such as reporting mechanisms and indicators, for the education needed to build awareness about identified problems in Stage Two; (3) to integrate the scientific knowledge into the decisions society takes to address the problems in Stage Three; and (4) in Stage Four, to institutionalize not only the agreed-upon solutions, but also the means to periodically reassess the effectiveness of the solutions so that the problem does not reappear and society does not slip back into unconscious incompetence with respect to the problem.

These elements of procedures for integrating science with decisionmaking exist in many contexts. Four diverse, yet reasonably successful models, may be compared in order to highlight their common reliance upon environmental scientific expertise and the means used to integrate science into decisionmaking: (1) the use of scientific bodies in the international decisionmaking under multilateral environmental agreements; (2) the integration of science with decisionmaking for nuclear-fueled electrical generating facilities; (3) the role of science in environmental impact assessments; and (4) the integration of environmental sciences into corporate environmental management decisionmaking. These types of procedures can be established in the second, third, or fourth stages of environmental awareness, whenever the political and policy consensus to do so can be mustered.

#### *A. Resistance to Procedural Reforms*

Before examining these four illustrative processes, a word of caution is in order. Experience suggests that establishing these

processes has been neither easy nor wholly effective. Quite apart from the multi-disciplinary challenges of the endeavor, scientists or others who would move an environmental problem from Stages One to Four encounter difficulties because rarely will there be complete agreement that reforms appropriate to cope with an environmental problem identified by scientists are necessary or important. Resistance to proposals to establish such procedures comes from diverse sources, and scientists often pay little heed to these perspectives. Many scientists themselves *know* the importance of their findings about environmental problems and assume that others will at once understand and ascribe the same importance; they have little patience for apparently tedious and imprecise governmental deliberations. Some individuals, who doubt the need to establish procedures to integrate science with decisionmaking, distrust scientific proposals for reform altogether. Many of those who oppose environmental reforms generally decline to consider the value of applied methods, such as environmental impact assessment procedures, dismissing them without much consideration as a result of their general disregard for the political activism of environmentalists.

Beyond the scientific community itself, there are other stronger views resisting the consideration of scientific information and any reform premised upon them. For instance, some not convinced that environmental trends pose serious threats are sure that any environmental problems can be adequately handled through a more robust use of private property rights.<sup>122</sup> Still other individuals believe that environmental law is somehow part of an extreme environmentalism that threatens today's lifestyles and the progress that produced contemporary prosperity.<sup>123</sup> Some confuse sound environmental management systems with "command and control" regulations and would disavow both.<sup>124</sup>

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122. See Terry L. Anderson & J. Bishop Grewell, *Property Rights Solutions for the Global Commons: Bottom-Up or Top-Down?*, 10 DUKE ENVTL. L. & POL'Y F. 73 (1999); see also *THE GREENING OF U.S. FOREIGN POLICY* (Terry L. Anderson & Henry I. Miller eds., 2000).

123. See, e.g., RAY, *supra* note 43; JULIAN L. SIMON & HERMAN KAHN, *THE RESOURCEFUL EARTH* (1984).

124. For instance, Congressman Thomas DeLay in 1995 introduced legislation to repeal the 1990 Clean Air Act Amendments and their protection of the stratospheric ozone through the ban on CFC use. The bill recited that "Public Law 101-549 is hereby repealed." As the *Financial Times* notes, the bill had no chance of adoption, but reflected its sponsor's views. "He commonly refers to the environmental protection agency (EPA) as the 'Gestapo of government.'" Deborah McGregor,

Others, particularly the timber and mining interests that derive wealth from the extraction of natural resources, oppose the reforms of environmental law because they limit the economic advantage of those vested interests.<sup>125</sup> At the other extreme, strong-willed environmentalists often have little patience with what they see as temporizing, too moderate, or wholly "bureaucratic" techniques such as establishing or refining environmental impact assessment procedures or scientific definitions of indicator measurements to monitor trends in ambient environmental systems.<sup>126</sup> Even traditional, well-organized environmental civic organizations rarely include procedural reforms for integrating science and decisionmaking among their legislative or political priorities.<sup>127</sup> Thus, reforms to introduce techniques appropriate to integrate scientific knowledge into decisionmaking face both political opposition and disinterest.<sup>128</sup>

Notwithstanding such resistance, the field of environmental law has introduced a range of new systems and techniques, professionally streamlined them to achieve administrative efficiencies, and enhanced their application. These legal methods

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*Republican Zealots May Test Nerve of Conciliatory Bush*, FIN. TIMES, Dec. 8, 2000, at 4.

125. Bill Holmes, a former member of the California State Board of Forestry, has said:

In California we continue to plunge toward new ill-fated experiments in socialized timber management. The Hollywood crowd and other people in the U.S. who hate America while worshipping Russia and its totalitarian system have jumped into bed with their environmental friends who welcomed them with open arms. They already had a great deal in common because, although not all left-wing radicals are environmentalists, certainly all environmentalists embrace some form of left-wing radical collectivism. As a result, the greatest threat to you, to me, to our communities, to our state and to our nation is no longer communism, it is not drugs, not AIDS, not crime, not poverty, not even liberal democrats, but radical environmentalism.

Bill Holmes, *Presentation to the 1991 Redwood Region Logging Conference*, reprinted in *GLOBAL ECOLOGY: A NEW ARENA OF POLITICAL CONFLICT* (W. Sachs ed., 1993).

126. See, e.g., DAVID FOREMAN, *ECODEFENSE: A FIELD GUIDE TO MONKEYWRENCHING* (3rd ed. 1985).

127. For instance, both the Carter and Clinton administrations entertained proposals to abolish the Council on Environmental Quality in the White House and remove the crucial presidential oversight of the government-wide National Environmental Policy Act's environmental impact statement process, which integrates science into decisionmaking. Virtually none of the major conservation organizations sought to contest these proposals.

128. In this regard, the reforms discussed in this Article share the fate of "good government" reforms generally. Because they are procedural in nature, they are not dramatic and their value is not immediately apparent to many members of the public, media, or decisionmakers.

for introducing scientific knowledge into decisionmaking deserve closer study and wider application. Use of these techniques has demonstrably moved natural resource use toward more sustainable, less environmentally degrading circumstances. Rather than weaken the environmental legal process or policies, the ensuing debates by opponents of environmental reforms have tempered the substantive and procedural foundations and framework for this field of law.

Environmental law reforms frequently can emerge from the controversy that accompanies many environmental issues. Such controversies have raged since the origins of this youthful legal discipline. The evolving scientific evaluation of Earth's natural systems leads to different perceptions about Earth's natural systems and natural resources. Even relatively small questions about use of a natural resource can trigger significant policy debate. Predictably, then, there needs to be some process for resolving disputes. While new scientific knowledge challenges the prevailing assumptions about natural resource use, this knowledge also implicitly threatens the social institutions that were founded on outdated knowledge. These new perceptions confront the inertia and well-entrenched force of societal convictions regarding the previously accepted *status quo*.

Such clashes between the new and old perceptions are not new phenomena. They appeared at the outset of ecological thinking. The philosophical roots of an environmentalist policy framework are found in Ralph Waldo Emerson's essay *Nature*,<sup>129</sup> which challenged the society's view of natural systems as commodities. His essay inspired Henry David Thoreau, John Muir, John Burroughs, and the first generation of conservation leaders in the United States.<sup>130</sup> When Oliver Wendell Holmes wrote his biography of Emerson,<sup>131</sup> Holmes quoted Thomas De Quincey to explain the public's antipathy to the new ideas about nature: "Whatever is too original will be hated at first. It must slowly mould a public for itself; and the resistance of the early thoughtless judgments must be overcome by a counter-resistance to itself, in a better audience slowly mustering against the first."<sup>132</sup>

That there is sometimes strong public reluctance to accept the new scientific findings regarding Earth's natural systems is

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129. See generally RALPH WALDO EMERSON, *NATURE* (1836).

130. See generally PAUL BROOKS, *SPEAKING FOR NATURE* (1980).

131. OLIVER WENDELL HOLMES, *RALPH WALDO EMERSON* 70 (Daniel Aaron ed., 1980).

132. *Id.*

thus predictable. Since there will always be dispute arising from the different perspectives concerning natural resources, the legal system should devote special attention to formulating neutral rules that provide for the full exposition of relevant scientific knowledge, for the deliberate consideration of that knowledge, and then for a reasoned resolution of disputes about any given environmental problems. For the resolution to be based on a careful study of scientific knowledge, there must be procedures for the presentation and consideration of scientific analysis. UNCED's recommendations regarding science for sustainable development do not expressly propose such procedures but do implicitly endorse their need. *Agenda 21* notes that "[o]ften there is a communication gap among scientists, policy makers, and the public at large, whose interests are articulated by both governmental and non-governmental organizations. Better communication is required among scientists, decision makers, and the general public."<sup>133</sup> *Agenda 21* calls for the strengthening and design of "appropriate institutional mechanisms at the highest appropriate local, national, subregional and regional levels and within the U.N. system for developing a stronger scientific basis for the improvement of environmental and developmental policy formulation."<sup>134</sup> *Agenda 21* urges more research to develop and use "quality-of-life indicators,"<sup>135</sup> proposes enhanced tracking and rapid exchange of data on global change trends,<sup>136</sup> and recommends development of a "methodology to carry out national and regional audits and a five-year global audit on an integrated basis."<sup>137</sup> Elsewhere *Agenda 21* recognizes that:

[t]o effectively integrate environment and development in the policies and practices of each country, it is essential to develop and implement integrated, enforceable and effective laws and regulations that are based upon sound social, ecological, economic and scientific principles. It is equally critical to develop workable programmes to review and enforce compliance with the laws, regulations and standards that are adopted.<sup>138</sup>

It was not *Agenda 21*'s purpose to delineate more precisely what substantive legislation or procedural rules should be

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133. *Agenda 21*, *supra* note 8, ¶ 35.5.

134. *Id.* ¶ 35.7(c).

135. *Id.* ¶ 35.7(d)(1).

136. *See id.* ¶ 35.12(l).

137. *Id.* ¶ 35.17(b).

138. *Id.* ¶ 8.14.

adopted. Instead of devoting time and effort to envisioning new and untried ways to address such recommendations, it would be useful to study and elaborate on techniques for which experience exists, and to build reforms or new recommendations on elements derived from proven models. Since the agreement on *Agenda 21* in 1992, there has been very little such analysis.<sup>139</sup> It is beyond the scope of this Article to do more than call for a renewed effort to evaluate the legal research in order to make it more widely understood by policymakers.

To illustrate some of the extant procedures for integrating science and decisionmaking, four proven legal methods from four distinct sectors may be considered. The decisionmaking systems used in each of these examples share common elements, which can be compared with reference to the stages of environmental awareness in the paradigm described above. From an in-depth study of these systems, one can elucidate the successful elements that could be further adapted or replicated. The first system discussed is drawn from international law. It concerns the use of scientific expert bodies in multinational environmental agreements (MEAs) to address scientific consensus across nations and cultures, so that diplomats and their responsible national officials can rely on the scientific recommendations. The second example consists of administrative law procedures, originally launched under the Atomic Energy Act of 1954,<sup>140</sup> which integrate scientific assessment with decisionmaking that must reconcile complex issues of technology and safety. The third model, and most valuable because of its multi-disciplinary features and the rich experience already available at local, national, and international levels of governance, is the environmental impact assessment procedures originally implemented through the National Environmental Policy Act of 1969.<sup>141</sup> Finally, it is useful to examine the efficient management systems for environment, health and safety (EHS) established by some of the leading multinational corporations for their own internal environmental

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139. One important example of such empirical research has been the research on the effectiveness of international environmental agreements, undertaken through The International Institute for Applied Systems Analysis (IIASA) in Vienna. See ENVIRONMENTAL CHANGE AND INTERNATIONAL LAW (Edith Brown-Weiss ed., 1992). This sort of study is needed for national legislative frameworks, for instance on managing surface water quality, aquifers, migratory species habitat, maintaining ambient air quality, minimizing wastes, and other areas addressed by Environmental Law.

140. See Atomic Energy Act of 1954, ch. 4, 42 U.S.C. §§ 2051-2053 (1994).

141. See National Environmental Policy Act of 1969, 42 U.S.C. §§ 4321-4370e (1994).

management uses, now extending well beyond mere issues of compliance with applicable environmental laws.

*B. Scientific Bodies in Multilateral Environmental Agreements*

Since a multilateral environmental agreement (MEA) is formally recognized as a treaty,<sup>142</sup> states are lawfully bound to observe its terms.<sup>143</sup> For the most part, the MEAs address environmental systems shared by all or many nations, or address transnational effects extending across many nations. Often declarations of states, such as the World Charter for Nature,<sup>144</sup> become the policy basis for treaties. Thus states take these "soft law" proclamations about states' duties seriously since they may later be the basis for framing "hard law" treaties. Even when the principles for a treaty are agreed upon, the scientifically complex nature of environmental agreements requires that decisions about implementing MEAs are deferred to the Conference of the Parties (COP) established under the treaty. In terms of the environmental awareness paradigm, when states adopt a soft law declaration they are generally in Stage Two, and when they negotiate and sign a MEA they are at the threshold of Stage Three. Once an MEA is negotiated, it establishes the framework to address the identified environmental issue. It is then important for scientific knowledge to be readily available if science is to be a core component of environmental decisionmaking by the diplomats and the governments that they represent. Therefore, a process is needed to assemble extant scientific knowledge relevant to the MEA's issues and to present it to decisionmakers.

The very small secretariats for the MEAs, staffed by international civil servants, are not structured to include the world's leading scientists. Similarly, most diplomats who represent states at the COP meetings are not scientists, nor, for the most part, do they have access to leading experts. The COPs for the MEAs tend to rely on committees of leading experts proposed by and approved by the states that have ratified the MEA. Thus, for instance, the Convention for the Conservation of

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142. See Vienna Convention on the Law of Treaties, May 23, 1969, art. 2(1)(a), 1155 U.N.T.S. 331.

143. See *id.* art. 26.

144. Adopted by the United Nations General Assembly on October 29, 1982, by 111 to 1 (the USA voting no); U.N. General Assembly Resolution 37/7, U.N. GAOR, 37th Sess., reprinted at 22 I.L.M. 455 (1983).



Antarctic Marine Living Resources (CCAMLR)<sup>145</sup> requires the Commission (effectively the COP) to “formulate, adopt and revise conservation measures on the basis of the best scientific evidence available,”<sup>146</sup> and establishes a Scientific Committee authorized to seek the advice of other scientists and experts as well.<sup>147</sup> The Commission may also establish subsidiary bodies necessary to perform its functions,<sup>148</sup> and thus could constitute further bodies of experts as needed.

A different model is employed by CITES.<sup>149</sup> While CCMLAR covers a wide range of issues, CITES has a specific focus. Rather than establishing an international scientific body, CITES links the “Scientific Authority” in every nation party to the Convention through the process of regulating trade in endangered species.<sup>150</sup> The COP<sup>151</sup> agrees on the lists of species that are in danger of extinction,<sup>152</sup> which is essentially a scientific judgment.<sup>153</sup> The scientific authorities in the case are closely linked to the diplomats sent to the COP (and can be one and the same). The COP is authorized to admit to the COP “any body or agency technically qualified in protection, conservation or management of wild flora and fauna.”<sup>154</sup> The CITES Secretariat is authorized to “undertake scientific and technical studies in accordance with programmes approved by the COP”<sup>155</sup> and IUCN provides scientific and technical information to these entities.

The Convention on Biological Diversity (CBD)<sup>156</sup> includes an express obligation for state parties to “promote and encourage research which contributes to the conservation and sustainable use of biological diversity . . . in accordance with decisions of the COP taken in consequence of recommendations of the Subsidiary Body on Scientific, Technical and Technological Advice” (SBSTTA).<sup>157</sup> The Convention establishes the SBSTTA

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145. Convention on the Conservation of Antarctic Marine Living Resources, May 20, 1980, T.I.A.S. No. 10240, 1329 U.N.T.S. 48 (1980).

146. *Id.* art. IX(1)(f).

147. *Id.* art. XIV(1).

148. *Id.* art. XIII(6).

149. See CITES, *supra* note 31.

150. See *id.* art. I(f) (including by reference arts. IX & IV (2)).

151. For a description of the role of the Conference of Parties (COP), see *id.* art. XI.

152. For a list of species regulated under the convention, see *id.* arts. II, XV, XVI, & apps. I, II, III.

153. Whether a species is “threatened with extinction” has been determined to be based on biological scientific assessment. *Id.* art. II.

154. *Id.* art. XI (7).

155. *Id.* art. XII (2)(c).

156. CBD, *supra* note 32.

157. *Id.* art. 12(b).

expressly and authorizes the COP to establish other subsidiary bodies as needed.<sup>158</sup> Like CITES, the CBD sets forth obligations relating to how the treaty will be implemented. The CBD contains broad obligations relating to the treaty's implementation. In addition, the CBD contains broad obligations for its state parties to "integrate consideration of the conservation and sustainable use of biological resources into national decisionmaking"<sup>159</sup> and to adopt measures "to avoid or minimize adverse impacts on biological diversity."<sup>160</sup> Promulgating policy and law on biodiversity is a very new field among most nations, requiring expansion of the traditional programs for protection of flora and fauna. There is not yet consensus within the COP about how many CBD obligations should be developed. Such decisions are inherently scientific, which makes the meetings of the SBSSTA an extremely important forum for establishing scientific consensus on the need to identify, request, gather, and exchange scientific information as a means to educate decisionmakers and help them arrive at a consensus. The CBD requires the meetings of the SBSSTA to be "multidisciplinary" and comprised of government representatives "competent in the relevant field of expertise."<sup>161</sup> Its mandate is broad: to undertake scientific and technical assessment and the conservation and sustainable use of biological diversity.<sup>162</sup> Recognizing that the work of the SBSSTA will doubtless evolve, the COP is authorized to further elaborate "the functions, terms of reference, organization and operation of this body."<sup>163</sup>

In contrast to these procedural systems for integrating the biological sciences with international decisionmaking, the emerging international law to manage Earth's atmosphere, a resource shared by all nations, illustrates the lack of agreement on how to develop a more systematic role for scientific knowledge. The U.N. Framework Convention on Climate Change (UNFCCC), like the CBD, expressly provides for a "Subsidiary Body for Scientific and Technological Advice."<sup>164</sup> However, because national decisionmakers consider the issues of global

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158. See *id.* art. 25.

159. *Id.* art. 10(a).

160. *Id.* art. 10(b).

161. *Id.* art. 25(1).

162. See *id.* art. 25(2)(a).

163. *Id.* art. 25(f)(3).

164. United Nations Framework Convention on Climate Change, May 9, 1992, art. 9, 31 I.L.M. 849 [hereinafter UNFCCC].

climate change to be more controversial than biological diversity, the states did not provide authorization for the UNFCCC's COP to ensure the same close integration of science with the deliberations of the COP. In the CBD, the COP is intended to "review scientific, technical and technological advice on biological diversity" developed with the SBSSTA,<sup>165</sup> while the COP for the UNFCCC merely "review[s] reports submitted by its subsidiary bodies and provide[s] guidance to them."<sup>166</sup>

The scientific contributions to the UNFCCC COP's debates on climate change come from other international sources outside the formal UNFCCC framework. The Intergovernmental Panel on Climate Change (IPCC), an international scientific study under the auspices of the World Meteorological Organization (WMO) and the U.N. Environment Programme (UNEP), with the cooperation of 350 scientists worldwide, has provided an independent assessment of how release of carbon dioxide from the combustion of fossil fuels may alter Earth's climate. The IPCC model is reminiscent of the model employed by the IUCN Species Survival Commission model *vis à vis* CITES, in that it engages teams of experienced scientific experts who operate independently in an institutionalized role. The scientists associated with the IPCC provide independent and objective scientific assessments which can be used by the states which have ratified the UNFCCC. Such systems, established outside of the treaty itself for providing scientific knowledge, may be more flexible, but they face the risk that states may not chose to rely upon them since such reliance is not required as is the case for scientific bodies set up explicitly by the MEA. Where scientific advice is organized and present outside of formal treaty provisions, there is the possibility that some states will be unwilling to consider the advice. For the moment, the scientific evaluations and models prepared by the IPCC are important because decisionmakers have an environmental awareness of the issue and its potential problems. The IPCC's initial reports had galvanized the states at the Second World Climate Conference in Geneva (November 1990) to call for the negotiation of the UNFCCC; this lends authority to the IPCC. It is instructive, however, that the states negotiating the UNFCCC chose to make no express provision for the IPCC. A sign of maturation of the

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165. CBD, *supra* note 32, art. 23(4)(c). The COP is also authorized to "establish such subsidiary bodies, particularly to provide scientific and technical advice, as are deemed necessary for the implementation of this Convention." *Id.* art. 23(4)(g).

166. UNFCCC, *supra* note 164, art. 7(2)(j).

UNFCCC would be for it to institutionalize a mechanism, such as the IPCC, for a regular ongoing scientific research program.

An even less institutionalized approach for considering scientific knowledge is found in the Vienna Convention for the Protection of the Stratospheric Ozone,<sup>167</sup> and the Montreal Protocol and other related agreements and protocols. The Vienna Convention obligates states to directly, or through competent international bodies, undertake scientific research<sup>168</sup> and “promote or establish, as appropriate, directly or through competent international bodies” joint or complimentary programs for systematic study of the stratospheric ozone layers, under terms outlined in Annex I to the Convention.<sup>169</sup> The parties obligate themselves to exchange scientific and other information.<sup>170</sup> The COP has the duty to review scientific information on the ozone layer,<sup>171</sup> and may establish subsidiary bodies, but no scientific body is set up in the Convention. Annex I sets forth a detailed agenda for scientific study into the physics and chemistry of the atmosphere, and the health, biological, and photodegradation effects of the depletion of the stratospheric ozone layer. These studies were undertaken in a variety of joint, bilateral, or national endeavors, but not as primary functions of the COP. The parties’ decisions to take action to reduce emissions of substances that deplete the ozone layer were made in the Montreal Protocol, which also required cooperation “in promoting public awareness of the environmental effects of the emissions of controlled substances and other substances that deplete the ozone layer.”<sup>172</sup> The COP for the Montreal Protocol was authorized to make its own decisions, without reference to an obligation to seek or receive scientific studies.<sup>173</sup> While science is essential to define the problems and potential solutions surrounding the ozone layer, the states do not institute any means to ensure the ongoing use of scientific knowledge other than a duty for the Secretariat to exchange whatever reports are provided.<sup>174</sup>

A related atmospheric issue in which scientific knowledge is well established, but has not induced sustained responses by

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167. See generally Vienna Convention, *supra* note 89.

168. See *id.* art. 3(1).

169. *Id.* art. 3(2).

170. See *id.* art. 4.

171. See *id.* art. 6(2)(b).

172. Montreal Protocol, *supra* note 90, art. 9(2).

173. For provisions governing the operation of the COP, see *id.* art. 11(3).

174. See *id.* art. 12.

decisionmakers in response, is the problem of acid rain. The Geneva Convention on Long-Range Transboundary Air Pollution of 1979<sup>175</sup> provides for a system of ongoing research and development of knowledge about and methods to abate air pollution,<sup>176</sup> to exchange information,<sup>177</sup> and to establish "The Co-operative Programme for the Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe" (EMEP).<sup>178</sup> The Geneva Convention establishes an Executive Body (effectively the COP)<sup>179</sup> and expressly provides that it "shall utilize the Steering Body for the EMEP to play an integral part in the operation of the present convention, in particular with regard to data collection and scientific co-operation."<sup>180</sup> The Executive Body overlaps with the Senior Representatives of their nations to the U.N. Economic Commission for Europe, and the U.N. ECE provides the Secretariat services for the Geneva Convention. The MEA is part of the ongoing pan-European effort to abate air pollution and reduce the emission of the precursors of acid rain. However, it can advance only as quickly as nations allocate resources to abate transboundary air pollution. The pace of pollution control is slower than the spread of the damage from resulting acidic precipitation.<sup>181</sup> More troubling still is the regional nature of this treaty. While there are bilateral agreements between Canada and the United States to abate acid rain,<sup>182</sup> there are no comparable agreements in any other region of the world. For lack of an international research program on acid rain and systematic delivery of information to decisionmakers, the problem of acid rain is in environmental awareness Stages One or Two throughout the world today.

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175. See generally Geneva Convention, *supra* note 94.

176. See *id.* art. 7.

177. See *id.* art. 8.

178. *Id.* art. 9.

179. See *id.* art. 10.

180. *Id.* art. 10(3).

181. Since the European Union, and its accession states, plus the rest of the economies in transition in Central Europe, domestically have relegated acid rain abatement to a relatively low level of priority *vis à vis* other priorities, the environmental awareness of the decisionmakers is not advanced to the level in Stage Three where the support exists to competently implement the Geneva Convention, even with its sensible system for integrating science with the decisionmaking. Here it is the decisionmaking at the international and national levels that is not adequately integrated. The example does show that the integration of science must also be at the national levels.

182. Memorandum of Intent Between Canada and the United States Concerning Transboundary Air Pollution, August 5, 1980, U.S.-Canada, 32 U.S.T. 2521, T.I.A.S. No. 9856, 20 I.L.M. 690 (1981).

Even this cursory comparison of the legal frameworks for several MEAs makes evident the elements of procedures for coupling science with decisionmaking. All of the MEAs could be strengthened by developing more standard international process for the inclusion of scientific knowledge and support for ongoing scientific research and publication, and also for the technological applications and managerial measures appropriate to address environmental problems. In addition, there is a need to identify the appropriate national scientific entities, whether governmental, academic, or non-governmental, which states should enlist to develop and exchange scientific knowledge relevant to the implementation of the agreements. Without such measures, any arrangement for implementation that emerges will lack a system, a professional identity, and the critical element of accountability. When an MEA relies upon *ad hoc* arrangements, there is the risk that the provision of scientific knowledge can become result-driven, politicized, or neglected.

The MEAs are part of the international effort to establish the international law for sustainability. Despite the recommendations of *Agenda 21* to integrate science into decisionmaking, the legal procedural systems for doing so remain modest at best. They can be strengthened, and elements that merit further study include the following: (1) establishment of an express duty for decisionmakers to consider scientific knowledge, together with procedures to record such consideration before a decision is made; (2) provision of an expert committee or body of scientists to structure the agenda for scientific research, build links to other scientific authorities, and help educate decisionmakers and build awareness of current scientific findings; (3) the formation of procedures to identify focal points or responsible national scientific authorities that will cooperate with the international expert committee; and (4) the establishment of requirements for submission of ongoing reports, with appropriate benchmarks or indicators of document changes, as part of a routine, systematic, and continuous scientific research program tailored to the environmental problem under study. Implementing such elements does not ensure that a decisionmaker will not ignore or arbitrarily reject the scientific advice, but it makes this eventuality far less likely. Moreover, when the scientific knowledge defines an environmental problem in such acute terms that it can no longer be ignored politically, the data will be assembled to help competently move through Stage Three.

### C. *Procedures of Nuclear Licensing Boards*

In administrative procedures within the federal government of the United States, there are many procedures that seek to integrate scientific knowledge with decisionmaking. Where the scientific advice is purely voluntary, the choice either to consider or ignore it is left up to the decisionmakers' discretion. The environmental advice on policy issues provided by the Council on Environmental Quality to the President often suffers this fate, but at least the statutory provisions of NEPA do require that the CEQ annual report must be prepared and presented.<sup>183</sup> The CEQ regulations,<sup>184</sup> as discussed below, require that the responsible administrator in each and every federal agency consider scientific environmental information. Moreover, the presence of CEQ as a statutory component of the Executive Office of the President makes it more likely than not that environmental considerations will be presented. Since 1970, every presidency has had instances when the CEQ chairman played a significant role in ensuring that environmental factors were considered among competing factors in presidential decisions. Similarly, Congress has mandated that there be a Science Advisory Board within the federal Environmental Protection Agency that evaluates any proposed environmental criteria document, standard, limitation, or regulation required by several federal statutes.<sup>185</sup> At the level of a state, a similar integration of scientific and legal disciplines is illustrated by the New York State Freshwater Wetlands Appeals Board. Thus, an institutionalized role for scientific knowledge in decisionmaking will be considered in a national framework when the law expressly requires it, just as it does in international law for the scientific subsidiary bodies under an MEA.

If scientific knowledge is to be fully developed and considered in national decisionmaking, it needs to be made systematic and routine. There are many examples of where this is successfully done, but none deserves further study more than the role of the quasi-judicial administrative licensing and appeals boards for the construction and operation of civilian nuclear power plants that generate electricity. Although today there is little political will to license new nuclear electrical generating facilities in the United States, the regulations for the

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183. See 42 U.S.C. § 4341 (1994).

184. See 40 C.F.R. § 1500.1 (2000).

185. See 42 U.S.C. § 4365 (1994).

permits for the siting, construction, and operation of such facilities provide useful models for integrating science into decisionmaking.

After it was established in 1954, the Atomic Energy Commission (AEC) developed an elaborate administrative law-permitting regime, including a system for convening licensing boards and licensing appeals boards.<sup>186</sup> An administrative law judge presides over these boards. With the enactment of NEPA in 1969,<sup>187</sup> the organic legislation establishing the AEC was amended to require these boards to undertake environmental impact assessments.<sup>188</sup>

The Atomic Energy Commission was established with the mission both to advance further scientific knowledge about nuclear energy and to promote the safe use of atomic energy to generate electricity. To enhance the independence of decisions on safety, in 1978, President Carter decided that the decisionmaking should be based on an objective scientific analysis, and not be influenced by the AEC's statutory mission to promote the nuclear power industry.<sup>189</sup> The Nuclear Regulatory Commission (NRC) was constituted to succeed to the AEC's regulatory responsibility, including its duties under NEPA.

The licensing board procedures merit study because they have half a century of experience incorporating scientific knowledge into decisionmaking. Throughout its history, and especially at the beginning, the AEC and NRC licensing boards have been composed of many scientists and have been receptive to scientific inquiry. The NRC procedures for deliberations before a licensing board provide useful elements for the sort of specific rules that could become generic models for integrating scientific knowledge into actual administrative decisionmaking. Although there have been many theoretical debates on whether or not society should have "science courts," the AEC/NRC licensing boards are an established system which have in fact used and

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186. The Atomic Energy Commission (AEC) was established to further the scientific knowledge about, as well as to advance and control the use of, atomic energy. Under President Carter, its regulatory role over control of the nuclear industry was divorced from its research and development missions. As an institution, the AEC was composed of many scientists and was receptive to scientific inquiry in its decisionmaking. See <http://www.nrc.gov>.

187. See generally National Environmental Policy Act of 1969, 42 U.S.C. § 4321 (1994).

188. See *Calvert Cliffs' Coordinating Comm. v. U.S. AEC*, 449 F.2d 1109, 1114 (D.C. Cir. 1971).

189. Atomic Energy Act of 1954, 42 U.S.C. §§ 2011-2281. See generally D. FORD, *THE CULT OF THE ATOM* (1982).



refined methods to prepare a record with scientific knowledge adequate for a decision, with scientists participating and with lawyers as decisionmakers. The regulations promulgated for the permits for the siting, construction, and operation of such facilities offer useful models of ways to integrate science into decisionmaking.<sup>190</sup> The NRC has an elaborate administrative law regime for granting permits for the construction<sup>191</sup> and operation<sup>192</sup> of nuclear power plants for generating electricity. These permits are granted by the NRC based on the decision of a formally constituted licensing board. Although an administrative law judge presides over such boards, each panel often does include a scientist with expertise appropriate to the licensing issues presented.<sup>193</sup> The regulations explicitly require that two of the three Licensing Board members "shall have such technical or other qualifications . . . appropriate to the issues to be decided" in the licensing. Thus, a panel to consider a license application for a nuclear power facility near an earthquake fault would have geologists appointed to the panel, or a licensing panel for a facility near an estuary would have an aquatic biologist. Intervention is liberally allowed,<sup>194</sup> and the regulations make express provision for intervention on environmental matters.<sup>195</sup> The Licensing Board's decision stands as the Commission's decision, unless an appeal is taken to the NRC.<sup>196</sup> By including scientists with relevant expertise to licensing applications on the licensing panels, the NRC ensures that environmental scientific knowledge will be incorporated into its decisionmaking.

In the course of its decisionmaking, the NRC,<sup>197</sup> like all federal agencies, must also comply with the environmental impact assessment procedures (EIA) of NEPA. Perhaps the most significant refinement to the NRC rules was the result of the implementation of the environmental impact assessment procedures of NEPA. Although scientific considerations were always critical for the AEC, the Commission delimited its

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190. See 10 C.F.R. § 2 (1999).

191. See *id.* §§ 2.4, 2.6.

192. See *id.* § 2.1.

193. See *id.* § 2.721(a).

194. See *id.* § 2.714.

195. See *id.* § 2.714(b)(2)(iii).

196. See *id.* § 2.760.

197. Initially, the AEC had not embraced fully its duty to examine all environmental impacts as required under NEPA. See *Calvert Cliffs' Coordinating Comm. v. U.S. AEC*, 449 F.2d 1109, 1112 (D.C. Cir. 1971). The EIA duties of the NRC under NEPA are now well acknowledged. See, e.g., *Baltimore Gas & Elec. Co. v. NRDC*, 462 U.S. 87 (1983).

consideration of scientific matters narrowly in accordance with its mandate from the Atomic Energy Act of 1954. When NEPA was enacted in 1969, the AEC did not consider that its organic act had been amended, and its licensing boards declined to look at all environmental impacts. The decision in *Calvert Cliffs Coordinating Committee v. AEC* altered this limited view.<sup>198</sup> The AEC had previously examined the scientific and technical aspects of the cooling systems for an atomic power plant, but not the effects of the cooling systems on the ambient environment. Thus, so long as the cooling system's design could draw water from a river or estuary to safely cool the nuclear reactor for the electrical power generating facility, and then either discharge the water or recycle the cooling water through a hyperbolic cooling tower, the AEC saw no reason to examine questions beyond safety and design, such as the impacts on the aquatic community of life or the atmosphere, or the aesthetics and landscape impacts of a cooling tower. The federal courts disagreed with the narrow, "crabbed" AEC interpretation<sup>199</sup> and ordered the AEC to fully comply with the obligations established under NEPA. The NEPA procedures subsequently adopted by the Nuclear Regulatory Commission have become detailed, involving extensive scientific inquiry.<sup>200</sup> The NRC's new procedures provide for a diligent analysis of scientific knowledge by the NRC's decisionmaking authorities. The NRC environmental impact assessment process requires development of such research as may be needed to develop further scientific data about possible environmental impacts and how to avoid or mitigate them.

These NRC procedures usefully illustrate Stages Three or Four of the environmental awareness paradigm. Nuclear power plants are never without some element of public controversy; what the NRC presents is a competent process to hear all points of view and to weigh the competing scientific and other issues raised by a nuclear power plant's operations.<sup>201</sup> Even where the

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198. See *Calvert Cliffs*, 449 F.2d at 1109.

199. Judge Skelley Wright criticized efforts by the AEC to avoid preparing the detailed statement that NEPA expressly required. "We believe that the Commission's crabbed interpretation of NEPA makes a mockery of the Act." *Id.* at 1117.

200. See, e.g., *New England Coalition v. NRC*, 582 F.2d 87 (1st Cir. 1978).

201. The current popular distrust of nuclear plants in the U.S.A. reflects the role of political considerations in how decisionmakers view scientific information. Despite the advanced NRC process for weighing scientific knowledge (a refined Stage Three level), environmental awareness about launching new civilian nuclear electrical power generating facilities has extended beyond the acceptance of the NRC licensing boards and (also at Stage Three) has coalesced around a position of not encouraging construction of any new facilities. Meanwhile, the lack of agreement on how to

public pays little attention to NRC review of a power plant by a Licensing Board, the regulations and statutes require the decisionmaking board to consider scientific knowledge competently. The role of the science and environmental impact assessment in the work of the NRC may be deemed to have reached the level of unconscious competence.

*D. Environmental Impact Analysis: The Once and Future NEPA Process*

NEPA's contribution to integrating scientific knowledge with decisionmaking has extended far beyond the AEC; it is arguably the most important innovation that environmental law has provided. NEPA's generic procedures for environmental impact analysis (EIA) have become a standard process of international decisionmaking.<sup>202</sup> For instance, in addition to the other methodologies used to integrate scientific knowledge with decisionmaking, the Convention on Biological Diversity requires states to introduce appropriate procedures for requiring environmental impact assessment of any of their proposed projects that are "likely to have adverse effects on biological diversity, with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures."<sup>203</sup>

The EIA process, as established by Section 102(C) of NEPA, was created to integrate environmental sciences into decisionmaking affecting the environment.<sup>204</sup> Within a year of NEPA's adoption, California,<sup>205</sup> the Province of Ontario,<sup>206</sup> and the state of New South Wales in Australia<sup>207</sup> had each adopted their own "little NEPAs." Other states and nations followed. In 1976,

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handle the radioactive waste from the existing facilities is at the second stage of environmental awareness, as the waste is stored "temporarily" at the existing licensed facilities, and permanent waste repository decisions remain to be made.

202. See N. A. Robinson, *EIA Abroad: The Comparative and Transnational Experience*, in ENVIRONMENTAL ANALYSIS: THE NEPA EXPERIENCE 679 (Stephen G. Hildebrand & Johnnie B. Cannon eds., 1993) [hereinafter ENVIRONMENTAL ANALYSIS].

203. CBD, *supra* note 32, art. 14(1)(a).

204. See NEPA § 102(C), 42 U.S.C. § 4332(C) (1994).

205. See CAL. PUB. RES. CODE § 21000 (West 2001).

206. Province of Ontario, Environmental Assessment Act of 1975. See generally Robinson, *supra* note 202, at 685. The Act requires a period review of the role of EIA in Ontario, and a review is scheduled for next year. Critics of the Ontario EIA process seek to weaken the law, having failed to understand its value in terms of sustainable resources use and protection of environmental quality.

207. Australia's Commonwealth government enacted the Environment Protection (Impact of Proposals) Act in 1974, followed by Acts in New South Wales and other states. See Robinson, *supra* note 202.

New York adopted its State Environmental Quality Review Act.<sup>208</sup> By 1985, the European Union had decided to require each EU member state to enact standard EIA procedures.<sup>209</sup> The Russian Federation has adopted an EIA law known as "Ecological Expertise."<sup>210</sup> Worldwide, over 150 jurisdictions have established systems for EIA. Beyond the CBD, a number of international agreements have decided to require EIA. For instance, the U.N. Convention on the Law of the Sea requires EIAs.<sup>211</sup> The Convention on Transboundary Pollution requires EIAs on a Pan-European basis,<sup>212</sup> and as of 1998, the far-reaching Åarhus Convention on Access to Information, Public Participation in Environmental Decisionmaking, and Access to Justice in Environmental Matters<sup>213</sup> provides a standard method for EIA procedures that includes judicial review of decisions.

In all of these contexts, EIA obligates decisionmakers to set forth a careful exposition of a proposed action, assemble a competent scientific analysis of the possible impacts on the environment, open their information and process to participation by interested parties and the public, accept comments or additional scientific information about the proposal and the assessment, and then undertake a conscious deliberation about the environmental effects of the proposal and how to avoid or mitigate those effects. In many instances, the decision is subject to an appeal in a court or a higher administrative authority, ensuring that the process has been diligently followed. This

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208. SEQRA, art. 8, N.Y. Envtl. Conserv. Law § 8-0101 *et seq.* (McKinney 1972).

209. Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment (June 27, 1985), Official Journal of the European Communities L 175/40.

210. Federal Law of Ecological Expertise, Russian Federation, enacted by State Duma July 19, 1995, approved by the Soviet of the Federation on Nov. 15, 1995, signed into law by President Boris Yeltsin.

211. The Law of the Sea states:

When States have reasonable grounds for believing that planned activities under their jurisdiction or control may cause substantial pollution of or significant and harmful changes to the marine environment, they shall, as far as practicable, assess the potential effects of such activities on the marine environment and shall communicate reports of the results of such assessments in the manner provided in article 205.

United Nations Convention on the Law of the Sea, Dec. 10, 1982, art. 206, 21 I.L.M. 1261.

212. See Espoo Convention on Environmental Impact Assessment in a Transboundary Context, Feb. 25, 1991, 30 I.L.M. 800.

213. See Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, June 25, 1998, 38 I.L.M. 517, available in <http://www.unece.org/env/pp>.

generic EIA process works because it incorporates scientific knowledge at the very point of decisionmaking.

The strength of EIA, as Prof. Lynton Caldwell aptly put it, is that it is a procedure that obligates decisionmakers to look before they leap by requiring a review of applicable scientific information:

NEPA may be seen as a contrived, institutionalized answer to a people's recognition of its deficiencies. Through the impact assessment process written in to law we compel ourselves, as participants in self-government, to do what we know should be done in undertaking actions that may have consequences not immediately apparent. The EIS process institutionalizes patience, caution, and looking before leaping. Few if any among the critics of NEPA would act in their personal affairs in the manner that government decision makers formerly acted in relation to the environment.<sup>214</sup>

Since the steps of EIA are remarkably similar among the various nations, states, and agencies employing the process, there is a rich body of decisionmaking available for further analysis. EIA seems to function at its best when it is subject to judicial review, as is NEPA,<sup>215</sup> or as it is in state courts of California and New York. The negotiators of the Århus Agreement have concurred in this judgment and required that parties to the Århus provide for judicial review through "access to the justice" provisions in the treaty.<sup>216</sup>

Each of the procedural elements of EIA merit in-depth study as effective tools to integrate science into decisionmaking. Scientists often criticize EIA because the scientific analysis in an EIS lacks peer review rigor.<sup>217</sup> Scientists do not concern themselves with revising the EIS process to seek remedies for their concerns; rather, they are content to leave the "science" in

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214. L. K. CALDWELL, *SCIENCE AND NEPA* 150 (Univ. of Ala. Press, 1984).

215. See, e.g., *Sierra Club v. U.S. Forest Service* 46 F.3d 835 (8th Cir. 1995).

216. Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, *supra* note 213, art. 9.

217. See, e.g. B. F. Leon, *Survey of Analyses in Environmental Impact Statements*, in ENVIRONMENTAL ANALYSIS, *supra* note 202, at 657 (stating that "[t]he consequences of the prevailing lack of rigor in current EISs are numerous. An untestable prediction has no credibility except for that of its author who must now become an *expert* if the report is to be believed. It is easy to find an *expert* who disagrees, and no one can prove either to be correct. Lawyers can discredit *experts* much more easily than they can discredit a carefully thought-out experimental design and testing program. If an EIS does stand because *experts* say it should, then the *experts* become the true decision makers and are inextricably drawn into the political process of project approval. Environmental policy is subverted, and one suspects projects of having hidden environmental impacts.").

the EIS process to consultants. Rarely do scientific institutes become involved in the EIA for specific controversies about siting new facilities, such as shopping centers, highways, or new suburban housing projects. Scientists see little professional advantage in applying their own scientific knowledge to such prosaic projects and see the risks of being drawn into time-wasting controversies. Yet it is the proliferation and cumulative impact of such facilities that erode the habitat for species as they consume open space, or incrementally contribute greenhouse gases to warm the atmosphere and induce modification of climate. If science is to make a sustained contribution to making EIA more effective, then procedural innovations are needed to better link scientific research to the EIA process, even for prosaic projects, and the disincentives that discourage participation of scientists in EIA must be neutralized to the greatest extent possible.

Procedures for EIA can be improved. Little serious reform of these procedures has been undertaken with the goal of more effectively integrating scientific knowledge with EIA procedures. One set of related proposals can illustrate the need for such further study. The currently isolated EIS reviews should be integrated into regional scientific studies of wider scope and duration.

One means to facilitate integration of science with EIA is to ensure that each EIA is grounded in a well-structured regional database of environmental quality baseline information, and in turn contribute new information to that database. Geographically specific scientific research needs to be maintained on a sustained basis over years for environmental trends to be understood. Funding for that sort of research process could come from the projects that already pay for the costs of the EIA itself as a modest fee for the baseline data provided. Procedures could be established for the study of specific impacts, in a consistent way, with data contributing to an empirical record of analysis. Such sustained support for basic scientific analysis could go a long way toward overcoming the reluctance of scientists (other than consultants) to take EIA seriously. Financing of a common environmental database for a river basin, for example, could ensure that current scientific knowledge would be available to decisionmakers when they needed it.

Empirical data describing a natural system should be prepared comprehensively and in a competent fashion, without being "for" or "against" a project such as a new shopping center.

Budgets for an EIS undertaken in the context of small, site-specific new developments are finite, so EIA tends to focus narrowly and employ existing knowledge. If it were part of a broader ongoing geographic study, and the EIS data was retrieved from each project-specific EIS and shared more broadly, then the quality of the analysis would improve and the data could be peer reviewed. The predictions in an EIS could be reviewed and studied over time.

Currently, extensive data collection is only seriously undertaken for major projects, such as decisions regarding siting a nuclear power plant, major highway construction, or new natural gas pipeline routes. In such cases, the decisions to expend substantial sums of money on new empirical scientific research investigation are possible because the overall cost of the project is sizable and will be amortized over the life of the plant. No attempt is usually made, however, to correlate the ecological and other studies for such specific projects with the long-term scientific research in the region. There should be a requirement in the scoping of the EIS<sup>218</sup> that the EIS correlate its scientific data collection and analysis with all ongoing scientific studies in the region where the project is located.

If all EIA could be based on data derived from regional scientific analysis of hydrologic, ecological, or other scientific knowledge about the place, there would be a better scientific foundation for the environmental assessment. EIS funding could help sustain the regional database; since financing could come from all economic activity that impacts the environment, the costs would be spread over a larger user base. Well established scientific institutes in universities or government agencies could be funded to undertake the research and make it available widely.

Through the use of computerized geographic information systems (GIS), this regional database of scientific knowledge could be made available to all on the Internet. Currently, most EIS reports are useless beyond the specific decision for which they are prepared. Most are discarded, and the data is lost after the project is completed. A vast body of empirical analysis is being lost for lack of a system to assemble and collate the assessments as they are completed. Such EIS information is public domain, but the procedural systems to integrate this accumulated knowledge into ongoing decisionmaking are

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218. For a definition of "scope," see 40 C.F.R. § 1508.25 (2000); see also 43 Fed. Reg. 55,990 (Nov. 28, 1978).

virtually non-existent. The EIA process needs to incorporate methods to collect and make available the environmental analysis generated through EIA.

Although EIA procedures can be enhanced, EIA potentially is the most effective system available for integrating scientific knowledge into decisionmaking at the point where an informed choice can be made in the context of a specific project's environmental impact, either to alleviate a trend of environmental degradation or let it grow worse. Where EIA succeeds, it is because it does link science to a decision, critiques the scientific presentations, and facilitates public debate about the evaluation of alternatives to the proposed actions. Where EIA works professionally and routinely, its processes are at Stage Three of environmental awareness. Unlike the agency-specific process of NRC's licensing boards, or the use of scientific bodies in specific MEAs, EIA applies across all decisionmaking systems and in each of them. Its processes can be made as ubiquitous as are the decisions about the environment. EIA can serve broader integrative functions.

#### *E. Corporate Environmental Management Systems*

A principal trait shared between those MEAs that have established processes for integrating scientific knowledge into their treaty decisionmaking, the licensing procedures of the Nuclear Regulatory Commission, and the generic EIA procedures is that each is a thoughtfully crafted *system*. Each organizes knowledge and integrates it with decisions. Given the difficulties in efforts to closely link scientific knowledge with the different stages in a decisionmaking process, the procedures need to mature over time, benefiting from the experience of several generations of involved individuals. A formally promulgated system facilitates this; information systems are apt to lapse or lack a consistent level of attention. Some "feedback" process is needed to critique performance of the process. Where the links in the process are *ad hoc*, or restricted to a single event, those responsible for the consideration of the scientific knowledge do not gain sufficient experience to accomplish the task well. A system can be refined and professional. In contrast, an *ad hoc* approach, even with the best of intentions, tends to last only as long as its progenitors.

The advantages of a systematic approach are clearly evident in the experiences of the companies that have established effective environmental management *systems* (EMS). Companies



that have the most advanced EMS have promulgated formal procedures for their application and are constantly improving their systems.<sup>219</sup> Corporate EMS is not a static approach, but an ongoing set of tasks tied to a clear mission. EMS enables corporate decisionmakers to understand the environmental considerations relevant to their company and to maintain the integration of scientific environmental knowledge with their operations at Stages Three or Four.

EMS in companies has progressed through three phases since the emergence of contemporary environmental law. Early EMS initially began in many companies as a way for the company to ensure that it could comply with the myriad of new environmental regulations in its operating locations.<sup>220</sup> Companies sought to avoid liabilities associated with violations of laws and avoid remediation costs for sites contaminated with long disposed of wastes. Senior management considered the environmental compliance staff as necessary "cost" centers, not desirable "profit" centers tied into the company's manufacturing. During this initial phase, companies frequently relied on consultants to design and even provide their environmental law compliance programs, which came to be known as "Environment, Health and Safety" (EHS) programs within companies.

More reflective and far-sighted company management, such as 3M's environment, health and safety director, Dr. Joe Ling, soon discovered that its company could go beyond managing risk and assuring compliance; it could also enhance profits by cutting expenses through eliminating waste. 3M's "Pollution Prevention Pays" program was soon emulated by Dow's "Waste Reduction Always Pays" (WRAP) program. In this second phase of the development of corporate EMS, companies hired full-time environmental scientific and technical staff as part of their

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219. The World Environment Center, established at the initiative of the U.N. Environment Programme in 1974, with headquarters in New York City, has an International Environment Forum (IEF) composed of some of the world's leading multinational companies. The members of the IEF all have refined EMS systems. The process of re-examining and improving the corporate EMS process is recognized annually by the conferring of the WEC Gold Medal to the company with the most effective EMS systems. An independent jury confers the medal, for which the annual competition is always keen. The WEC periodically revises its award criteria to raise the bar in light of the advances in corporate EMS practices. For information about the World Environment Center, see generally <http://www.wec.org>.

220. The emergence of a corporate practice in Environmental Law was evident as early as 1970, and the growth of EMS was a maturing of management systems. See N. A. Robinson, *New Dimensions of Corporate Counseling in Environmental Law*, 1 COLUM. J. ENVTL. L. 7 (1974).

routine operations. Management had discovered that by establishing standard procedures, providing routine training, and conducting ongoing internal environmental auditing of operations, they could redesign their manufacturing process to promote efficiency and avoid consuming unnecessary raw materials. Senior corporate management came to regard EMS as a kind of "profit" center for their company, capable of improving the "bottom line" performance.

Drawing on the experience of the companies pioneering in EMS, the International Standards Organization (ISO) has developed its ISO 14000 series to guide the systemization of the second phase of environmental management and provide for auditing procedures.<sup>221</sup> While ISO 14000 is a voluntary process, some countries, such as Singapore, have encouraged its use for the facilities of all companies nationwide. Companies evaluate their environmental performance and invite audit of their environmental management procedures. A significant number of U.S. companies are ISO 14000 certified and many others have adapted the ISO 14000 approach to structure their own EMS. For standard EMS, a company must use an audit to demonstrate that it has the capacity to collect relevant environmental information, evaluate it, develop compliance indicators, and ensure compliance with established environmental legal and professional standards. Today, the U.S. Environmental Protection Agency promotes a standard for environmental auditing,<sup>222</sup> as does the European Union.<sup>223</sup> *Agenda 21* expressly promotes such EMS procedures within companies.<sup>224</sup>

Internationally, a number of companies have moved beyond eco-efficiency and EMS into a third phase. These companies have developed more thorough internal management systems, integrating environmental with other social indicators of sustainability.<sup>225</sup> The companies examine the entire social context and environmental aspects of their operations and shape

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221. INT'L STANDARDS ORG., ISO 14000—MEET THE WHOLE FAMILY (1998), available at <http://www.iso.ch/9000e/iso14000.pdf>.

222. See U.S. Env'tl. Prot. Agency, *Environmental Auditing Policy*, 51 Fed. Reg. 25,004 (July 9, 1986).

223. *Allowing voluntary participation by companies in the industrial sector in a Community eco-management and audit scheme*, European Union: Council Regulation (EEC) No. 1836/93 of June 29, 1993. See OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES, No. L 168/1 (10.7.93).

224. See *Agenda 21*, *supra* note 8, ¶¶ 30.2-30.4.

225. See, e.g., Int'l Chamber of Commerce, *The Business Charter for Sustainable Development*, available at <http://www.iccwbo.org/home/environment/charter.asp>.

management policies to ensure that company operations can avoid disruption and operate as progressive corporate citizens.<sup>226</sup> Environmental and social considerations are included in the design of the products or services being provided. In this phase, EMS is such an integral part of a company's core mission that it actually is deployed to help the company achieve a competitive advantage over other companies providing similar products or services.

Indeed, as companies complete a full analysis of their products' life cycles—from initial conceptualization to the issues related to its ultimate disposal—some companies are reconceptualizing their products and redefining how they fulfill their core market purposes, such as shifting from selling only a specific kind of product toward selling the services that are associated with the functions of that product. If the customer can buy just the service desired, and not be saddled with disposing of the worn-out product, and if the components of the service can be recycled and reused, the overall savings accrue to society at large and not just to the individual company. Municipalities handle less refuse,<sup>227</sup> less electricity is required, and fewer scarce materials are consumed. If customers are drawn to the company whose services are most convenient and regarded as being more sustainable, this company can gain a competitive advantage over its competition.

Sustainable environmental management systems look at a company's multiple stakeholders, including customers, suppliers, neighbors, local government, investors, non-governmental organizations, and others.<sup>228</sup> This combination of management systems has been termed "Corporate Social Responsibility," and defines the company's mission in terms of achieving commercial success in ways that honor ethical values and respect people, communities, and the natural environment.

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226. An example of programs that promote corporate social responsibility are those of the organization Business for Social Responsibility, see <http://www.bsr.org>; it promotes a wider kind of auditing for this broader agenda. Environmental management systems, including their scientific monitoring elements, are contained within a wider set of company policy. This is well illustrated by the *Social and Ethical Auditing, Accounting, and Reporting* (SEEAR) procedures of the Institute of Social and Ethical Accountability based in London, U.K. See, e.g., <http://www.accountability.org.uk>; <http://www.globalreporting.org>.

227. The U.N. University launched in 1994 a "Zero Emissions Research Initiative" to research the systems that could be employed to eliminate all significant wastes. For information about the Initiative, see <http://www.ias.unu.edu/ecology/g%5Feconomy/unu%5Fzef.htm>.

228. See, e.g., CAUX ROUND TABLE, PRINCIPLES FOR BUSINESS, available at <http://www.cauxroundtable.org>.

Corporate social responsibility is an integration of the now traditional EHS programs, with a wider set of concerns for stakeholders in the communities within which companies have operations, for consumers, and for the wider set of social interests beyond the environment. Company policies for corporate social responsibility do not supplant EHS, but embrace it in a wider context.

With respect to the integration of environmental science into corporate decisionmaking, the success of eco-efficiency, EMS, and these more recent "Corporate Social Responsibility" practices offer instructive models. These corporate "best management practices" share the following elements: the systems are formally established, with basic policy set by the Board of Directors and standard operating procedures promulgated at each level of company operations; personnel are trained to implement the procedures, and their performance reviews include evaluation of how well they implement the applicable EMS; there are objective indicators for monitoring compliance and periodic reviews at the level of the operations; and finally, there is an annual report to shareholders, and a feedback process for receiving responses to the reported information.

One of the most effective corporate sustainable environmental management approaches is that of the Bristol-Myers Squibb Company. This company has developed a system derived from a corporate board policy on environmental stewardship. In 1991, Bristol-Myers established that its initial EMS goals were to be 100% compliance with applicable laws, to have zero injuries and illnesses, to emit zero pollution, to have prompt, cost-effective, risk-based cleanups, and to behave as a good environmental citizen.<sup>229</sup> In 1992, Bristol-Myers prepared an environmental performance report that measures the company's corporate EHS performance against the sixteen voluntary and aspirational principles for environmental management set forth in the International Chamber of Commerce's Business Charter for Sustainable Development (1991).<sup>230</sup> Based on this assessment, Bristol-Myers adapted the broad principles of the Charter to meet the specific circumstances of a pharmaceutical company by promulgating a series of Codes of Practice, and composing a document on

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229. See BRISTOL-MYERS SQUIBB, ENVIRONMENT 2000—POLLUTION PREVENTION THROUGHOUT THE PRODUCT LIFE CYCLE (1992).

230. Int'l Chamber of Commerce, *supra* note 225.

Environmental Health and Safety Guidance. Performance criteria, with measures and benchmarks, were established for each of the sixteen environmental dimensions, and progress was reported routinely to internal sources, shareholders, and the public. By 1993, Bristol-Meyers had based its company-wide environmental stewardship programs on six elements: (1) product life cycle management, (2) continuous environmental improvement, (3) accountability for actions, (4) creation of an employee environmental ethic, (5) open communication with stakeholders, and (6) active participation in the resolution of environmental challenges at local, national, and international levels.<sup>231</sup> It tailored its scientific and technical staff to match its environmental stewardship goals.

All of these measures are part of what Bristol-Meyers calls "Environment 2000," the company's "blueprint for establishing protection of the environment as a company-wide priority."<sup>232</sup> Charles A. Heimbold, Jr., president and CEO of the company, stated: "We are carrying forward these commitments through comprehensive management systems. These support ongoing environmental performance not merely as necessary regulatory requirements, but also as an opportunity for gaining competitive advantage in the marketplace."<sup>233</sup> It developed an EHS Guideline on property transfers and then applied the practice to mergers and acquisitions of new companies. By 1995, Bristol-Myers reported its progress in each of the sixteen sectors of the ICC's Business Charter. It continued its internal measuring and auditing and also employed external consultants to conduct an assessment of its corporate EHS evaluation program.<sup>234</sup> In 1999, the company adopted "on the path to sustainable development" as the theme of its report.<sup>235</sup> It detailed its "Management System Components," which include full cost accounting and its corporate evaluation program. Bristol-Myers outlined how it engages its major stakeholders, and reported its management performance and operational performance. For the first time, the Company reported on its efforts at preserving biodiversity, both

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231. See BRISTOL-MYERS SQUIBB, 1993 REPORT ON ENVIRONMENTAL PROGRESS 12 (1993).

232. BRISTOL-MYERS SQUIBB, ENVIRONMENT WORLD 1 (1994).

233. *Id.*

234. BRISTOL-MYERS SQUIBB, 1995 REPORT ON ENVIRONMENTAL, HEALTH, AND SAFETY PROGRESS 12 (1995), available at <http://www.bms.com/static/ehs/sideba/data/ehsr95.pdf>.

235. BRISTOL-MYERS SQUIBB, 1999 REPORT ON ENVIRONMENTAL HEALTH AND SAFETY PROGRESS 1 (1999), available at <http://www.bms.com/static/ehs/sideba/data/ehsr99.pdf>.

*ex situ*, such as the preservation of biologically diverse land on the outskirts of Brazil's Pananal National Park, and *in situ* through contributions to the New York Botanical Garden. It also supported the Rain Forest Alliance with a portion of the profits from Clairol's *Herbal Essences* line of products.<sup>236</sup> In addition, it articulated its policy on genomics and bioprospecting.<sup>237</sup>

Bristol-Myers reported performance against social and economic indicators at the same time. It reported an evaluation of product performance, articulating its focus on sustainability as follows:

Sustainable development presents both challenges and opportunities for Bristol-Meyers Squibb. The *challenge* is to manufacture and market products that minimize negative economic and environmental impacts. The *opportunity* is to leverage responsible environmental management into a competitive advantage for our company. We recognize that doing business in a sustainable manner encourages innovation and therefore is essential to developing and maintaining competitive advantage in the marketplace.<sup>238</sup>

The Bristol-Meyers example is instructive in terms of establishing and refining systems to effectively use science and technology in environmental decisionmaking. The corporate example holds lessons for the other three procedural case studies. Science is essential to the very existence of a pharmaceutical company, just as it was at the founding of a governmental agency such as the Atomic Energy Commission. What is significant is that Bristol-Meyers has incorporated into its management system a process of reassessment and review. Had the AEC established comparable systems, it should have been able to comply with NEPA without the necessity of being ordered to do so by a federal court. Similarly, if the NRC had developed a culture of ongoing improvement in its NEPA regulations, it could now consider establishing new procedures for decommissioning plants and reassessing the broader environmental and social implications presented when owners of currently operating nuclear power plants endeavor to extend their plants' "useful life." Had the President of the United States articulated through the CEQ a strong government-wide

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236. See *id.* at 21. The company notes that "[o]ver a five-year period, we have identified over \$7 million in product improvements, driven in part by the quest to minimize environmental impacts through this product life cycle (PLC) initiative." *Id.* at 28.

237. See *id.* at 34.

238. *Id.* at 26.

environmental policy comparable to that which the President and CEO of Bristol-Myers Squibb announced, agency compliance with NEPA might be stronger and a process to refine and advance NEPA could be established. Similarly, the still relatively recent procedures of the MEAs make virtually no provision for routine monitoring and assessment, and the decisionmakers in the COPs, mostly diplomats who serve short periods of time before being reassigned by the foreign ministries to new posts, show little understanding of the need to establish a system that dictates how their fledgling institution will integrate scientific knowledge into its ongoing deliberations.

Bristol-Meyers' development and maintenance of the highest quality of scientific capacity for its research and product development may not be surprising, since these account for its products and commercial mission. What is significant is that the same high standards are now applied in the EMS and increasingly in the corporate responsibility sector. *Agenda 21* had recommended that "business and industry . . . should increase research and development of environmentally sound technologies and environmental management systems, in collaboration with academia and the scientific/engineering establishments. . . ." <sup>239</sup> The leading companies have excelled in this respect. If *Agenda 21* were revised today, it would have to recommend that the scientific community and governmental authorities should study and apply some of the lessons that corporate EMS can teach.

Within companies, innovation in these procedures continues whereas, within government, the design of the EIA process has remained relatively static for years. The decisionmaking in company-wide environmental procedures appears to be more robust than that of national governments in this respect. Both government and non-governmental management systems, as well as companies that have not yet followed the example of Bristol-Myers, should study and adapt the Bristol-Myers elements for successfully integrating science into ongoing decisionmaking. The companies that have employed such advanced procedures systems are at Stage Four in the paradigm of environmental awareness. The remaining danger that concerns them is that new management, for instance as the result of a merger or acquisition, will lack the same environmental company ethic, and will reduce personnel to cut costs, thereby effectively weakening or abandoning the refined

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239. *Agenda 21*, *supra* note 8, ¶ 30.25.

process that took so much effort to create. Companies that are serious about sustaining their advanced EMS procedures will require regular external audits of their environmental management performance, to avoid this eventuality. Routine auditing provides quality control and a management review system. As corporate EMS procedures become pervasive, eventually environmental auditing will be as widely used and accepted as financial auditing has become.

#### CONCLUSION

Although it may appear tautological, until decisionmakers decide to take measures to integrate science into decisionmaking, science is not likely to be well integrated into decisionmaking. Since decisionmakers are unlikely to decide to integrate science into decisionmaking until environmental awareness of the problem has reached Stages Three or Four of the environmental awareness paradigm, some procedures must be contrived to induce the integration. Even at this point, as the weak arrangements of the UNFCCC illustrate, unless the decisionmakers understand the need to establish an ongoing system for relying upon scientific knowledge, their well-intended consideration of environmental scientific knowledge will be difficult to sustain over the long term. Newly elected or appointed decisionmakers will focus on their new challenges and, deliberately or unconsciously, they may well neglect to consider scientific knowledge, *unless* institutionalized systems build a process to sustain a reliance on scientific analysis and a capacity to respond periodically to new understanding of scientific knowledge.

The Four Stages of Environmental Awareness provide a paradigm for evaluating when decisionmakers may be predisposed to act to integrate science into their decisionmaking. Experience with environmental law suggests that when the awareness of a problem exists, it is as important to promote adoption of a *procedural system* by which science is necessarily an integral party of decisionmaking. This would appear to be the case whether the scientific issues involve the duties of a multilateral intergovernmental organization under international law into Earth's natural systems, or by a national or local inquiry into the environmental impact assessment of a new local land use.

Even when such procedural systems exist, they can be neglected and can lose their robust character. For instance, when the U.S. federal government phased the Soil Conservation



Service (SCS) out of existence,<sup>240</sup> the nation lost much of its system of scientific advice to local governments and property owners about how to avert erosion and sustain the vitality of soil. Although some state laws continue to focus on providing property owners and government agencies with information about soils science, which had been both a local and a national priority since the "Dust Bowl" in the 1930s, the federal program was eliminated as no longer needed. Ironically, the loss of the SCS came just as other nations were developing the Convention to Combat Desertification, and the SCS could have shared its expertise internationally about how to remedy desertification around the world. Although the United States paves over or renders useless topsoil at rapid rates, and although desertification is growing worse worldwide,<sup>241</sup> decisionmakers in the United States have allowed national concern for soil to drop from environmental awareness Stages Three or Four, back to Stage One. When measured from the perspective of sustainable soils policy, the United States is at a level of unconscious incompetence; decisionmakers rarely concern themselves with scientific knowledge about soils.

Because EIA has become a management system applied throughout the world, significantly more attention should be devoted to enhancing EIA as a system for integrating scientific knowledge into decisionmaking. For instance, as early as 1990 (when the Oak Ridge National Laboratory convened a symposium on the twentieth anniversary of NEPA), the EIA process was recognized as a tool that could be used to measure and abate or eliminate the emission of greenhouse gases,<sup>242</sup> the incremental loss of biodiversity,<sup>243</sup> or the impacts of acid precipitation.<sup>244</sup> With refinements, EIA procedures could also address the use of alternative technologies and substances in lieu of pesticides whose residues are persistent organic pollutants, or to accelerate substitutions for gases still in use that deplete the stratospheric ozone, or for stabilization of soils, or the elimination of pollution running off the land to contaminate surface waters. With better

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240. See K. Jack Haugrud, *Agriculture* § 8.3(a), in CECILIA CAMPBELL-MOHN, BARRY BREEN & J. WILLIAM FUTRELL, *SUSTAINABLE ENVIRONMENTAL LAW* (1993).

241. See generally Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, June 17, 1994, 33 I.L.M. 1328.

242. See, e.g., R. M. Cushman et al., *Global Climate Change and NEPA Analysis*, in ENVIRONMENTAL ANALYSIS, *supra* note 202, at 442.

243. S. Henderson et al., *Can NEPA Protect Biodiversity?*, in ENVIRONMENTAL ANALYSIS, *supra* note 202, at 463.

244. G. E. Saul & K. W. Thornton, *Environmental Monitoring and Assessment: A National Priority*, in ENVIRONMENTAL ANALYSIS, *supra* note 202, at 494.

evaluation of the processes that are now present internationally, EIA could help to measure, weigh cumulative impacts, and address how to cope with phenomena such as the gradual erosion of coasts to rising sea levels, or any of the other worldwide environmental problems that the scientific study of Earth's systems has revealed. If more systematic use of EIA were cultivated, the scientific community might find that decisionmakers would be willing to devote more sustained financial support for maintaining the scientific baseline data that the EIA process should use. Scientists have a role to play here.

Rather than tending to ignore the EIA process because its procedures have not been refined and because it currently involves a pedestrian level of applied science, the leadership of the scientific communities around the world might re-examine their interest in EIA and endeavor to rebuild the rigor of the scientific analysis in EIA at a highly competent level. EIA can serve to implement the findings of "sustainability science" worldwide, and in turn, the data generated in each EIA can be fed back into the models of "sustainability science." EIA is the single legal process available through which to coordinate at all levels, worldwide, the implementation of environmental stewardship goals derived from "sustainability science." It is time to reassess EIA, and to develop an approach learned from ISO 14000 for enhancing the professionalism of EIA.

Although the degrading trends with respect to Earth's ecological problems demand global solutions, no mega-solution is possible. Most of Earth's pervasive problems are being caused by many independent and individual causes; often the actors are unconscious of their contribution to exacerbating a global problem. The MEAs may be international treaty systems, but they depend entirely on national laws and programs for their implementation. The EIA process, available in many regions, needs to be introduced into all decisionmaking; it has the potential to be a worldwide system that can reach the independent and individual causes of global problems at each level of governance.

Despite this evident promise, little is being done to advance EIA today. NEPA is neglected in federal practice, and half the states have not yet enacted "little NEPAs." Where EIA has a foundation in a treaty or a statute, it will continue to be available as a process by which to require the consideration of science in decisionmaking. EIA can take a complex problem and reduce it to manageable components. EIA's flexible process allows decisionmakers to fashion nuanced and graduated solutions to

mitigate global degradation. Because the local contribution to global trends may appear to be remote or negligible, decisionmakers may not believe it necessary to invoke these EIA processes. Indeed, unless the rules of the EIA system require it, it is likely that decisionmakers will tend<sup>245</sup> to look only at the immediate environmental impacts, and not at mitigating the contribution to long-term impacts.

Advocates of reforms addressed to global environmental problems, such as the emissions of greenhouse gases, could use EIA to build environmental awareness as well as to promote measures to resolve the problems incrementally. Many of these advocates are non-governmental organizations (NGOs). The leaders of these NGOs, and their donors and supporters, take the EIA procedures for granted and ignore the potential that EIA offers to require decisionmakers to come to grips with the ways in which the scientific knowledge about global trends relates to the actions pending before them. This is a mistake.

EIA offers a strategic procedure to move issues from environmental awareness Stages One and Two into Stage Three. Because EIA focuses on a specific decision, it makes concrete and immediate the rather more "distant" trends of deterioration in global environmental systems. Because EIA must objectively assemble relevant scientific knowledge, it becomes a means for education, and because it is a transparent process with public participation required, it can build environmental awareness from Stages One to Two to Three. EIA may be used to that end or its procedures can be left to atrophy.

Of course, when the legal procedures are lax, as in the case of most international law regimes, or when administrators try to circumvent procedure in places with weak legal systems or those rife with corrupt practices, then procedural means such as EIA are not available. This deficiency in the decisionmaking system is not a reason to discount or reject procedures such as EIA, for the same would be true of any aspect of environmental law, or indeed of the rule of law itself. The environmental sciences already are being ignored in such places, and environmental awareness is often at Stages One or Two. Although distressing, such situations do dramatize the missing link. Without procedures to link science and decisionmaking, the sciences will be ignored.

Where procedures forge strong links, science becomes a major factor in enhancing and sustaining environmental quality.

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245. As the AEC did prior to the *Calvert Cliffs* decision.

This can also be illustrated with reference to the U.S. Clean Water Act's provisions for upgrading the classifications of surface water quality standards and eliminating effluents from pipes and other discrete sources. Here all procedural components of a *system* to link science and decisionmaking are in place; these elements include trained personnel employed in government agencies and companies (and often in NGOs), available equipment, indicator standards, monitoring and assessment of indicators, the review of advances in effluent control technology with regularly scheduled upgrades as available, administrative oversight, and judicial review. The procedures provide that effluent permits expire no later than every five years and cannot degrade water quality standards,<sup>246</sup> and since water quality standards must be reviewed for upgrade every three years,<sup>247</sup> the effluent permit can be made stricter and stricter as water quality improves and as the water quality standards are increased. When the decisionmakers who issue permits or upgrade water quality standards are in default, the Clean Water Act authorizes citizen suits to enforce these deadlines.<sup>248</sup> This process works well, and for nearly three decades the United States has sustained a nationwide procedure integrating science and decisionmaking for the purpose of controlling discharges from pipes into surface waters. The process functions manifestly at Stage Three of the environmental awareness paradigm.

The procedures from the system for surface water quality in the Clean Water Act illustrate a highly focused use of sustainability science. This model confirms that the links can be forged to link science and decisionmaking. The procedure is pervasive, extending across and applying evenly in all political jurisdictions throughout the nation, to all companies and governments, and to almost all discrete sources of water pollution effluents. Nonetheless, even the CWA system can lose its rigor in a given region or for a given factory. When administrative oversight is lax, only citizens acting in bringing a federal lawsuit to enforce the CWA keeps the cycle of integrated science and decisionmaking effective. Citizen suits are one of the systemic techniques that Congress designed in order to consciously sustain the competent functioning of the CWA at the third stage of environmental awareness.

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246. See Clean Water Act § 402(b)(1)(B), 33 U.S.C. § 1342(b)(1)(B) (1994).

247. See Clean Water Act § 303(c)(1), 33 U.S.C. § 1313(c)(1) (1994).

248. See Clean Water Act § 505(a), 33 U.S.C. § 1365(a) (1994).

In contrast, where a procedural link is missing and elements of a *system* are lacking, there is no consciously competent way of coping with an environmental problem. Here the Clean Water Act illustrates the problem. While science and law constrain deliberate discharges of pollutants to waters, the federal laws in the United States entirely fail to curb or eliminate pollution added by sheet run-off of pollutants across land or into storm drains. The Clean Water Act contains no legal system linking the scientific knowledge about contamination of surface waters to the decisionmakers in local governments, under whose authority most land use decisions are made. Here too NEPA or "Little NEPA" EIA procedures could be fashioned to identify the potential sources of run-off pollutants and then require the design of means to eliminate such run-off; indeed, until the job of the soil conservationist assigned by the SCS to a local area was eliminated, the soil conservationists often helped to provide the scientific knowledge needed for this EIA process. For the present, management of the run-off contamination of America's surface waters is at levels of unconscious or conscious incompetence.

Even where an environmental problem is at Stages One or Two, and there is no awareness of extant scientific knowledge about the problem, measures can be taken. Scientific endeavors can be undertaken to prepare for the integration of scientific knowledge with decisionmaking. For the sustainability sciences studying Earth's natural system to be integrated with decisionmaking, measures need to be taken to combine scientific databases and examine how to link them to environmental legal processes.<sup>249</sup>

If this Article has accomplished nothing else, it has established that there remains much to be studied regarding how *procedural systems* within environmental law can institutionalize consideration of scientific knowledge. The analytical Environmental Awareness paradigm can guide the strategic deployment of legal tools, such as EIA. In turn, scientific knowledge can advance the thresholds of public awareness toward actions establishing sustainable practices. Finally, legal procedures can be deployed to maintain the reforms.

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249. For instance, since most of the reports and studies for EIA are now electronically prepared, it would be rather easy to gather them and include them in a searchable database on the Internet. No scientific, governmental, or other body has taken this initiative.

In light of the time frames needed to move environmental awareness to Stage Three, it will take the work of more than two generations before environmental science becomes an integral part of decisionmaking on environmental problems. Realistically, given the resistance to reforms in decisionmaking about activities affecting environmental degradation, can this can be done? If the discrete field of environmental law has one cardinal characteristic around the world, it is to build and maintain those systems in governance that will support acceptance of *Agenda 21*'s "sustainability science" as a foundation for making society's decisionmaking.