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Climatic Change Apocalypse and Law*

Ray Jay Davis**

In the first century, according to the biblical account, John the Revelator saw in vision the Four Horsemen of the Apocalypse. He beheld the four grim riders as they thundered into his consciousness: conquest was astride the white horse; on the red rode war; famine was on the black horse; and the pale horse was ridden by death.¹ In the late twentieth century some climatologists and environmentalists have glimpsed an apocalyptic view of the planet's future—global climate change with its attendant environmental and societal implications.²

* An earlier version of this paper was given by the author in a talk at the American Meteorological Society Seventh Conference on Applied Meteorology held in Salt Lake City, Utah, September 10, 1991.

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1. *Revelations* 6:1-8.

2. THOMAS A. BODEN ET AL, *TRENDS '90: A COMPENDIUM OF DATA ON GLOBAL CHANGE* (1990); JOHN FIROR, *THE CHANGING ATMOSPHERE: A GLOBAL CHALLENGE* (1990); WILLIAM W. KELLOGG, *EFFECTS OF HUMAN ACTIVITIES ON GLOBAL CLIMATE* (World Meteo. Org. Tech. Note No. 156, 1977); WILLIAM W. KELLOGG & ROBERT SCHWARTZ, *CLIMATE CHANGE AND SOCIETY: CONSEQUENCES OF INCREASING ATMOSPHERIC CARBON DIOXIDE* (1981); STEPHEN H. SCHNEIDER, *GLOBAL WARMING: ARE WE ENTERING THE GREENHOUSE CENTURY?* (1989); William W. Kellogg, *Response to Skeptics of Global Warming*, 72 BULL. AM. METEO. SOC'Y 499 (1991). For the report of the committee on global climate change of the National Research Council, see NAT'L RES. COUNCIL, *RESEARCH STRATEGIES FOR THE U.S. GLOBAL CHANGE RESEARCH PROGRAM* (1990). The policy statement of the American Meteorological Society concerning world-wide temperature increase may be found at Am. Meteo. Soc'y, *Policy Statement on Global Climate Change*, 72 BULL. AM. METEO. SOC'Y 57 (1991).

The impacts of planetary warming are discussed in *THE CHALLENGE OF GLOBAL WARMING* (Dean E. Abrahamson ed., 1989); STANLEY A. CHANGNON, JR., *DROUGHT AND CLIMATE CHANGE* (Ill. State Water Surv. Res. Rep. 89-02, 1989); *CLIMATE IMPACT ASSESSMENT* (Robert Kates et al. eds., 1985); ANDREW GOUDIE, *THE HUMAN IMPACT ON THE NATURAL ENVIRONMENT* (3d ed. 1990); *THE IMPACT OF CLIMATIC VARIATIONS ON AGRICULTURE* (Martin Parry et al. eds., 1988) (2 vols.); *THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES* (Rep. to Congress for Env'tl. Protection Agency, Joel Smith & Dennis

Governmental policy concerning this modern horseman can be and is implemented by law. There are three kinds of relationships between law and climate change. They are: (1) applying existing law to new climatic parameters; (2) adapting to modified climate through using new legal rules; and (3) altering, by making and enforcing laws, anthropogenic factors causing global climate change. These legal relationships with climate alteration can exist in tandem. None are necessarily exclusive; all are part of the association of climate and law.

I. APPLICATION OF EXISTING LAW

The first type of law and climate modification interface involves no change in the law; it applies the modified climatological facts to existing legal relationships. There is a great deal of law relating generally to environmental quality³ and particularly to air quality.⁴ There are some laws about intended weather modification⁵ and, to a considerably lesser extent, concerning inadvertent changes in the weather.⁶ But as

Tirpak, 1988); Charles F. Cooper, *What Might Man-Induced Climate Change Mean?* 56 FOREIGN AFF. 500 (1978); Christopher Flavin, *Slowing Global Warming*, 96 AM. FORESTS 37 (1990); Norman J. Rosenberg, *Greenhouse Warming: Causes, Effects and Control*, 4 RENEWABLE RESOURCES J. 4 (1988).

Policy options for dealing with climatic change are considered in, HOWARD DANIEL, *MAN AND CLIMATIC VARIABILITY* (1980); POLICY OPTIONS FOR STABILIZING GLOBAL CLIMATE (Env'tl. Protection Agency Rep. to Congress, Daniel Lashof & Dennis Tirpak eds., 1989); FRANCESCA LYMAN ET AL., *THE GREENHOUSE TRAP: WHAT WE'RE DOING TO THE ATMOSPHERE AND HOW WE CAN SLOW GLOBAL WARMING* (1990).

3. Two recent collections of materials are JOHN E. BONINE & THOMAS O. MCGARITY, *THE LAW OF ENVIRONMENTAL PROTECTION: CASES—LEGISLATION—POLICIES* (2d ed. 1992); ZUGMUNT J.B. PLATER ET AL., *ENVIRONMENTAL LAW AND POLICY: A COURSEBOOK ON NATURE, LAW, AND SOCIETY* (1992). See also, ROGER W. FINDLEY & DANIEL A. FARBER, *ENVIRONMENTAL LAW IN A NUTSHELL* (1988).

4. The scope and complexity of air quality laws are illuminated in MARK SQUILLACE, *AIR POLLUTION* (1988). For reports on recent additions to air quality law, see articles cited in note 65, *infra*.

5. See, e.g., ROBERT E. BECK, *Augmenting the Available Water Supply*, 1 WATERS AND WATER RIGHTS § 3.04 (Robert E. Beck ed., 1991); Ray J. Davis, *Weather Modification Litigation and Statutes*, WEATHER AND CLIMATE MODIFICATION 767 (Wilmot Hess ed., 1974); LEGAL AND SCIENTIFIC UNCERTAINTIES OF WEATHER MODIFICATION (William Thomas ed., 1977). The Weather Modification Association publishes a list of current weather modification laws and regulations from the United States and Canada. For the most recent, see *Current American and Canadian Weather Modification Legislation*, 23 J. WEATHER MODIFICATION 105 (1991).

6. See, e.g., RAY J. DAVIS, *THE LEGAL IMPLICATIONS OF INADVERTENT WEATHER MODIFICATION: METROMEX AND THE LAW* (Rep. to Nat'l Sci. Found.,

yet no significant body of legal norms has been designed specifically to respond to climate change.⁷ There are, however, laws whose application will be affected by alteration of climate. Even though they have not come into being because of climate modification issues, there are those laws whose application will be impacted by changed climate.

Emissions of greenhouse gases that are thought to produce global warming can lead to precipitation changes which in turn may have hydrologic consequences.⁸ For example, studies of the Great Lakes drainage demonstrate the system's climate sensitivity,⁹ and show the implications of climatic change for navigation and power generation.¹⁰ Streams are legally

1990); Ray J. Davis, *The Legal Implications of Inadvertent Weather Modification*, in PROC. SIXTH CONF. ON PLANNED AND INADVERTENT WEATHER MODIFICATION OF THE AM. METEO. SOC'Y AT CHAMPAIGN-URBANA, IL 122 (1977).

For analysis of inadvertent weather change (as contrasted with climatic alteration) caused by human activities, see T.J. CHANDLER, *URBAN CLIMATES* (World Meteo. Org. Tech. Note No. 108, 1968); Stanley A. Changnon, Jr., *Atmospheric Alterations from Man Made Biospheric Changes*, MODIFYING THE WEATHER: A SOCIAL ASSESSMENT 135 (W. R. Derrick Sewell ed., 1973). St. Louis, Missouri and its environs in Illinois and Missouri were the site for a detailed scientific study of the urban weather anomaly. For a summary of the reports from that project, see STANLEY A. CHANGNON, JR., ET AL., *SUMMARY OF METROMEX: WEATHER ANOMALIES AND IMPACTS* (1977).

7. It is anticipated, though, that some sort of framework convention pointing the way toward development of international law on anthropogenic climate change will emerge from the June 1992 United Nations Conference on Environment and Development to be held in Rio de Janeiro. The background of this conference is noted in Part III of this paper, *infra* at notes 44-50.

8. Robert M. Cushman, *Using Climate Model Output to Assess the Impacts of Climate Change on Water Resources*, WATER RESOURCES PLANNING AND MANAGEMENT AND URBAN WATER RESOURCES 679 (Jerry Anderson ed., 1991); John A. Dracup & Donald R. Kendall, *Floods and Droughts*, CLIMATE CHANGE AND U.S. WATER RESOURCES 243 (Paul Waggoner ed., 1990); John C. Schaake, Jr., & Zdzislaw Kaczmarek, *Climate Variability and the Design and Operation of Water Resource Systems*, PROC. WORLD CLIMATE CONF. AT GENEVA 311 (World Meteo. Org. Tech. Note No. 537, 1979).

9. F. Kenneth Hare & Stewart J. Cohen, *Climate Sensitivity of the Great Lakes System*, IMPACTS OF CLIMATE CHANGE ON THE GREAT LAKES BASIN 49 (Symposium at Oak Brook, IL, 1989).

For studies of the effect of climate change on the level of the Great Salt Lake, see Upmanu Lall & Taiye Sangoyomi, *Potential Impacts of Climate Change on the Hydrology of the Great Salt Lake Basin* (report on research in progress at the Utah Water Resources Laboratory, 1991); Peter M. Morrisette, *The Rising Level of the Great Salt Lake: An Analogue of Societal Adjustment to Climate Change*, SOCIETAL RESPONSES TO REGIONAL CLIMATIC CHANGE: FORECASTING BY ANALOGY 169 (Michael Glantz ed., 1988).

10. Marie Sanderson, *Implications of Climatic Change for Navigation and Power Generation in the Great Lakes*, 87-03 CLIMATE CHANGE DIG. 1 (1987); Andre Saulesleja, *Report on the Panel on Energy and Transportation*, IMPACTS OF

controlled by the "law of the river"¹¹—law which will be affected by climate related hydrologic variations. Increases in temperature that lead to reduced streamflow will trigger in the changed context application of present water law rules governing water shortages.¹²

The boundary waters shared by the United States and Mexico are the lifeblood of the arid states from both countries that rely upon the flow of those streams for agricultural, industrial, and domestic uses.¹³ International allocation of those rivers is controlled by agreements between the two countries. In the 1906 treaty related to the upper Rio Grande, the United States undertook to deliver Mexico 60,000 acre-feet

CLIMATE CHANGE ON THE GREAT LAKES BASIN 99 (Symposium at Oak Brook, IL, 1989). The Canadian Climate Centre has published a series of abstracted reports in the CLIMATE CHANGE DIGEST on the causes and impacts of climatic alteration. For a recent list of their reports, see Canadian Climate Program Board, *Climate Change and Canadian Impacts: The Scientific Perspective*, 91-01 CLIMATE CHANGE DIG. inside front cover (1991).

11. LEONARD RICE & MICHAEL D. WHITE, *ENGINEERING ASPECTS OF WATER LAW* 8 (1987).

12. For an explanation of that concept, see Frank J. Trelease, *Climate Change and Water Law*, CLIMATE, CLIMATIC CHANGE AND WATER SUPPLY (Nat'l Res. Council, 1977), quoted in FRANK J. TRELEASE & GEORGE A. GOULD, *CASES AND MATERIALS ON WATER LAW* 92-94 (4th ed. 1986).

It has been suggested that there is "at least modest precedent in American law for including climatic change as a factor in Supreme Court consideration of equitable allocation of waters among American states." James M. Strock, *Effects of Global Warming on International Treaty Obligations Relating to Water Rights*, COPING WITH CLIMATE CHANGE 682, 684 (John C. Topping, Jr. ed., 1989), citing *Washington v. Oregon*, 297 U.S. 517, 527 (1936); *Colorado v. New Mexico*, 459 U.S. 176, 183 (1982). See also *Nebraska v. Wyoming*, 325 U.S. 589, 618 (1945); James M. Strock, *Adjusting Water Allocation Law to Meet Water Quality and Availability Concerns in a Warming World*, PROC. FIRST NORTH AMERICAN CONF. ON PREPARING FOR CLIMATE CHANGE: A COOPERATIVE APPROACH 382 (1988).

Long-term anthropogenic influences on weather and climate have in fact been recognized by the Supreme Court in shaping its amended decree in *Wisconsin v. Illinois*, 449 U.S. 48 (1980), which modified the decree in the *Sanitary and Ship Canal Case* to permit accounting procedures for Illinois withdrawals of water from Lake Michigan based upon a 40-year moving period to allow for climate fluctuations. See Stanley A. Changnon, Jr., *Hydrologic Applications of Weather and Climate Information*, 1981 J. AM. WATER WORKS ASS'N 514, 517.

13. The Rio Grande rises in Colorado, flows the length of New Mexico, forms for a short distance the interstate boundary between New Mexico and Texas, and then becomes the international border between Texas on the American side and the Mexican states of Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas.

For the general history of the Rio Grande area and the impact of the river on it, see PAUL HORGAN, *GREAT RIVER: THE RIO GRANDE IN NORTH AMERICAN HISTORY* (rev. ed. 1960) (2 vols.). The legal history of the international portion of the river is covered in Albert Utton, *Mexican International Waters*, 5 WATERS AND WATER RIGHTS §§ 51.01-51.04 (f) (3) (Robert E. Beck ed., 1991).

each year.¹⁴ But there is an escape clause, applicable in the event of serious drought or accidental failure of supply in the United States, allowing cutting water deliveries to Mexico by the same proportion as deliveries in the United States are reduced.¹⁵ The broader 1944 treaty concerns the lower Rio Grande and the waters of the Colorado and Tijuana rivers.¹⁶ It allocates about half the lower Rio Grande water to each country. In one reach of the river, Mexico guarantees an average of at least 350,000 acre-feet per year to the United States over a five-year period. There is, however, a savings clause which authorizes Mexico to make up any deficiency in one five-year cycle in the next such cycle if the deficiency was caused by extraordinary drought or serious accident.¹⁷

The Colorado River portion of the 1944 treaty calls for delivery to Mexico of 1,500,000 acre-feet of water per year and establishes a schedule for maximum and minimum deliveries during particular months. However, in the event of serious drought or accident in the United States, minimum deliveries may be cut by the same proportion as are consumptive uses in the United States.¹⁸ The exceptions clauses in both treaties could be invoked by the upstream riparian nation in the event of climate change-induced deficiency in flow if that could be considered covered by the concept of serious or extraordinary drought as the treaties use those terms.

Interstate water laws allot American streams flowing among two or more states.¹⁹ Some of these laws also provide for water shortages. Those involving the Colorado River are examples. The Colorado River Compact splits the flow of that stream between the upper and lower river basins. Each basin was apportioned 7,500,000 acre-feet per year.²⁰ The Mexican treaty obligation is satisfied out of any excess above the 15,000,000 acre-feet allocated to the states, but in the event of insufficient flow to accomplish that, the basins bear the

14. Rio Grande Irrigation Convention with Mexico, May 21, 1906, U.S.-Mex., 34 Stat. 2953, T.S. 455, Art. I.

15. *Id.* at Art. II.

16. Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande, Feb. 3, 1944, U.S.-Mex., 59 Stat. 1219, T.S. 994.

17. *Id.* at Art. 4B.

18. *Id.* at Art. 10.

19. DAVID H. GETCHES, WATER LAW IN A NUTSHELL 397-415 (2d ed. 1990).

20. Congressional consent to the compact may be found at 45 Stat. 1057, 1064 (1928). The text appears at 70 CONG. REC. 324 (1928) and in the codes of the signatory states. See, e.g., UTAH CODE ANN. § 73-12a-2 Art. III (a) (1989).

deficiency equally. The upper basin undertook not to cause the river's flow to drop below an aggregate 75,000,000 acre-feet for any ten year period. This, however, is reckoned in continuing progressive series.²¹ Again, as in the agreements with Mexico, multi-jurisdictional water law considers the possibility of flows inadequate to meet required water deliveries. Averaging runoff and sharing shortages are available techniques, not only to cope with drought due to the weather cycle, but also to meet streamflow deficiencies caused by hydrologic consequences of climate change.

The upper basin states allocated among themselves their share of the Colorado River by a compact entered into in 1948. It allotted the water in the river on a percentage basis,²² and provided an apportionment mechanism for use in the event a curtailment of use was necessary to comply with the upper basin delivery requirement to the lower basin. If a state in the ten years before the year in which the curtailment becomes necessary used more than its share, it must supply that overdraft to the lower basin.²³ The compact created an Upper Colorado River Commission empowered to make findings of fact in the event of extraordinary drought or serious accident whereby Mexican deliveries may be affected so water available to the upper basin states may be reduced in conformity with the treaty.²⁴ Climate change related drought would be covered by the compact.

The lower basin states did not enter into a compact to divide their share of the Colorado. Rather the river's waters were apportioned by a combination of congressional action in the Boulder Canyon Project Act,²⁵ issuance of water delivery contracts by the Secretary of Interior,²⁶ and decision by the United States Supreme Court in its 1962 opinion in *Arizona v. California*.²⁷ In that case the court noted that neither the project act nor the water contracts requires any particular

21. UTAH CODE ANN. § 73-12a-2 Art. III(d) (1989 replacement).

22. 63 Stat. 31, 32-33 (1949); UTAH CODE ANN. § 73-13-10 Art. III (a) (1989 replacement).

23. UTAH CODE ANN. § 73-13-10 Art. IV (1989 replacement).

24. *Id.* at Art. VIII.

25. 45 Stat. 1057 (1928).

26. Section 5 is the statutory basis for the secretary's authority to conclude water delivery contracts. 45 Stat. 1057, 1060 (1928). The contracts and their legal effects are analyzed in *Arizona v. California*, 373 U.S. 546, 575-90 (1963).

27. 373 U.S. 546 (1963).

formula for apportioning shortages among the lower basin states.²⁸ The Supreme Court was unwilling to adopt a proration scheme like the Mexican water treaty treatment of Colorado River shortages. Neither did it rely on the notion of prior beneficial use nor on its own doctrine of equitable apportionment of interstate waters among riparian jurisdictions.²⁹ The Secretary of Interior may find these concepts provide useful guidance, but they do not bind his discretion. In the event of any shortfall due to climate change, the Secretary can consider such factors as "might be helpful in reaching an informed judgment in harmony with the Act, the best interests of the Basin States, and the welfare of the Nation."³⁰

Current water laws, although they seek to allocate rights to a variable resource, have not always functioned well during extreme drought. Water law, which is species of property law, is less flexible than an efficient allocation system could be.³¹ Up to a point, the "law of the river" rules developed for drought conditions could cope with low flows attributable to climate modification. But should flow deficiencies exceed those foreseen by the architects of rules concerning water shortages, existing legal mechanisms might or might not be adequate. Application of existing rules to impacts from global warming on international and interstate streams is an inadequate response to a possibly apocalyptic phenomenon.³² The law should be active rather than passive. Legal engineering is the preferable approach to coping with societal impacts arising from worldwide warming.

II. ADAPTATION TO CLIMATE CHANGE

The second sort of relationship between law and climate

28. 373 U.S. at 593-94.

29. *Id.* For discussion of apportionment factors used by the Supreme Court under that doctrine, see Douglas Grant, *Equitable Apportionment Suits Between States*, 4 WATERS AND WATER RIGHTS § 45.06 (Robert E. Beck ed., 1991).

30. 373 U.S. at 594.

For the history of allocation of the Colorado River, see NORRIS HUDLEY, JR., *WATER AND THE WEST: THE COLORADO RIVER COMPACT AND THE POLITICS OF WATER IN THE AMERICAN WEST* (1975).

31. See Charles W. Howe et al., *The Performance of Appropriative Water Rights Systems in the Western United States During Drought*, 22 NAT. RESOURCES J. 379 (1982).

32. See Gretta Goldenman, *Adapting to Climate Change: A Study of International Rivers and Their Legal Arrangements*, 17 ECOLOGY L.Q. 741 (1990).

change strives for better adaptation to new climatic circumstances by modifying law or implementing it differently. It is very American to "solve" societal problems by passing laws. Those difficulties associated with climate change also can be given the legal treatment. The point here is not to induce changes in human activities that are leading to climate change, but it is to react to possible societal impacts from climate alteration and attempt to mitigate their severity or enhance the chance that any beneficial aspects of such changes may be more widespread. The new legal norms react to the new climatological conditions.

One such reactive approach to mitigate losses is to pass relief laws. The prolonged drought of the second half of the 1980s across much of the country caused enormous agricultural losses. Although insurance mechanisms were in place to deal with such emergencies, they were not utilized widely enough to meet all the needs of farmers and ranchers. Pressures built to enact federal relief legislation. Drought conditions led directly to passage of the 1988 and 1989 farm relief bills.³³ It takes little imagination to foresee similar political pressures in the future as responses to negative impacts from climatic change. It is, of course, quite short-sighted to attempt legal management of such societal problems through heavy reliance upon emergency legislation.³⁴

Social engineering through law can be accomplished better by establishing planning machinery rather than through the band-aid approach. Planning law, using that term in the broad sense, is a legal device which can help adjust societal factors so biophysical and socio-economic impacts from climate change

33. Disaster Assistance Act of 1989, Pub. L. 101-82, Aug. 14, 1989, 103 Stat. 564; Pub. L. 101-134, § 1, Oct. 30, 1989, 103 Stat. 780; Pub. L. 101-220, § 9, Dec. 12, 1989, 103 Stat. 1882; Disaster Assistance Act of 1988, Pub. L. 101-82, title V, § 503, title VI, § 602, Aug. 14, 1989, 103 Stat. 586, 587; Pub. L. 101-239, title I, § 1004(a), Dec. 19, 1989, 103 Stat. 2108.

The climatic conditions and political pressures that culminated in adoption of these relief acts are analyzed by Stanley Changnon. Stanley A. Changnon, Jr., *Agricultural Impacts and Adjustments to the Drought of 1988-1989*, CLIMATE, AGRICULTURE AND DROUGHT: MISCELLANEOUS PAPERS 41 (Stanley A. Changnon, Jr., ed., 1991). See also BUREAU OF RECLAMATION, DEP'T OF INTERIOR, REPORT TO THE PRESIDENT AND THE CONGRESS, RECLAMATION STATES DROUGHT ASSISTANCE ACT OF 1988 (1991).

34. See the recommendations for improving drought management in the United States in WILLIAM E. RIEBSAME ET AL., DROUGHT AND NATURAL RESOURCES MANAGEMENT IN THE UNITED STATES: IMPACTS AND IMPLICATIONS OF THE 1987-89 DROUGHT 160-69 (1991).

can be rendered less detrimental or even made beneficial. Thus enacting laws in advance of serious impacts from the greenhouse gas emission-global warming-climate change-societal impacts chain of events, puts in place tools that can cope with the effects and will reduce society's vulnerability to them.³⁵

In order to incorporate more effectively environmental, social, and economic considerations into planning for cyclical water shortage, certain planning tools might be used. Legislation should delegate governmental authority for drought response and create mechanisms for automatically implementing and terminating a drought response plan, including temporary water use restrictions. The public should be notified of impending restrictions, and categories and classes of restrictions should be established according to both source and use with a statement of preference rankings. Enforcement of the program should be by appropriate measures.³⁶ Only seven states had taken this approach by the late 1980's. Two-thirds of the jurisdictions used emergency responses rather than planning efforts; these states relied primarily upon their general water rights system to manage drought-induced water shortages.³⁷

Land use planning has been approved by the Supreme Court as an appropriate response to legitimate aesthetic and social concerns;³⁸ it has been offered as a means of locating activities in areas which would be beneficial for them;³⁹ and it has been upheld in the well-known *Construction Industry Association of Sonoma County v. Petaluma*, case for growth control.⁴⁰ Thus, using planning devices to encourage shifting crop types can benefit persons in places newly suitable for such production. Also planning can discourage or even bar climate sensitive activities from locating where they would be less appropriate than previously because of changed climatic conditions.⁴¹

35. Donald A. Wilhite, *Drought Planning and State Government: Current Status*, 72 BULL. AM. METEO. SOC'Y 1531 (1991).

36. Margaret S. Hrezo et al., *Integrating Drought Planning Into Water Resources Management*, 26 NAT. RESOURCES J. 141 (1986).

37. *Id.* at 148-49.

38. *Enclid v. Ambler Realty Co.*, 272 U.S. 365 (1926).

39. Ray J. Davis, *supra*, note 6, at § 7.3.

40. 522 F.2d 897 (9th Cir. 1975), *cert. den.*, 424 U.S. 934 (1976).

41. Although the effects upon water resources of planetary warming are

Modern environmental law born during the 1950s and 1960s, grew explosively during the 1970s, and then was refined during the 1980s.⁴² A new class of government officials was created and given powers which sought to enhance environmental quality. Environmental law was added to traditional land use control.⁴³ This new legal machinery is designed both to mitigate the effects of environmental mismanagement and to reach its causes. The law not only helps mankind live with the consequences of pollution and other environmental ills, but also assists clean up. Similarly law can be employed to aid adjustment to climate change while it also seeks to reach the causes of the phenomenon.

III. ALTERATION OF CAUSES

Most discourse about law and climate modification involves the third kind of relationship between them—using law as a mechanism to affect climate change. Rather than working through law to adapt to anthropogenic climate alteration, law is employed to alter it by requiring changes in human activities causing planetary climate change, to fend off this latter day apocalyptic rider. A major theme of discussion considers legal strategies to reduce greenhouse gas emissions. The continuing escalation in carbon dioxide (CO₂) buildup in the

uncertain, it is certain that there will be both winners and losers as the consequence of climatic change. One prediction is that the greenhouse effect may increase overall American farm productivity. Thomas H. Maugh II, *The Flip Side of Global Warming*, L.A. TIMES, May 17, 1990, at Part A, 32. Studies from Canada have predicted mixed effects upon the country's agriculture. Louise M. Arthur, *The Implication of Climate Change for Agriculture in the Prairie Provinces*, 88-01 CLIMATE CHANGE DIG. 1 (1988); Barry Smit, *Climate Warming and Canada's Comparative Position in Agriculture*, 89-01 CLIMATE CHANGE DIG. 1 (1989). Computer modeling has been employed to predict the water resources effects of global climatic alteration. Myron B. Fiering et al., *Guidelines for Water-Resource Planning under Climate Change*, WATER RESOURCES PLANNING AND MANAGEMENT AND URBAN WATER RESOURCES 684 (Jerry Anderson ed., 1991). In addition to the hydrologic impacts that might be beneficial, greenhouse warming may directly benefit agriculture through carbon dioxide build up. Sherwood B. Idso, *The Aerial Fertilization Effect of CO₂ and Its Implications for Global Carbon Cycling and Maximum Greenhouse Warming*, 72 BULL. AM. METEO. SOC'Y 962 (1991). Idso's paper set off a flurry of letters to the editor. See, e.g., *Letters to the Editor*, 72 BULL. AM. METEO. SOC'Y 1905-14 (1991).

42. For a brief history of the environmental movement see THOMAS M. HOBAN & RICHARD O. BROOKS, *GREEN JUSTICE: THE ENVIRONMENT AND THE COURTS* 1-7 (1987).

43. See Michael F. Reilly, *Transformation at Work: The Effect of Environmental Law on Land Use Control*, 24 REAL PROP., PROB. & TR. J. 33 (1989).

atmosphere,⁴⁴ much of which comes from coal combustion,⁴⁵ and emissions of such other greenhouse gases as methane (primarily from rice production),⁴⁶ and chlorofluorocarbons (CFCs),⁴⁷ has led to consideration of a proposed international climate change convention. The United Nations Intergovernmental Panel on Climate Change has laid the foundation for an international framework convention for consideration at the twentieth anniversary meeting of the Stockholm Conference on the Human Environment which will be held in Rio de Janeiro, Brazil in June 1992.⁴⁸ Congressional action has been proposed which would, if passed, affect the American energy policy by mandating coal use reduction.⁴⁹ Tackling greenhouse gas emissions limitation is a job requiring both international and national legal activities.⁵⁰

44. THOMAS BODEN, ET AL., *supra* note 2. What to do about the CO₂ build up is the theme of Edith B. Weiss, *A Resource Management Approach to Carbon Dioxide During the Century of Transition*, WORLD CLIMATE CHANGE: THE ROLE OF INTERNATIONAL LAW AND INSTITUTIONS 167 (Ved Nanda ed., 1983).

45. Robert Schware & Edward Friedman, *Anthropogenic Climatic Change: Assessing the Responsibility of Developed and Developing Countries*, WORLD CLIMATE CHANGE: THE ROLE OF INTERNATIONAL LAW AND INSTITUTIONS 64 (Ved Nanda ed., 1983). Worldwide warming and energy policy are linked in GLOBAL WARMING AND THE CHALLENGE OF INTERNATIONAL COOPERATION: AN INTERDISCIPLINARY APPROACH (Gary C. Bryner ed., 1992).

46. Ralph J. Cicerone, *Methane in the Atmosphere*, GLOBAL CLIMATE CHANGE: HUMAN AND NATURAL INFLUENCES 91 (S. Fred Singer ed., 1989).

47. See discussion *infra* part III. A and notes 51-56.

48. In 1985 a conference of scientists was convened at Villach, Austria under United Nations auspices to assess the role of increased carbon dioxide and other greenhouse gases on planetary climatic change. After predicting an "inevitable" warming, the group urged governmental support of research, adoption of policy and economic options, and creation of a task force to "initiate, if deemed necessary, consideration of a global convention." Conference Statement from the UNEP/WMO/ICSU International Assessment of the Role of Carbon Dioxide and of other Greenhouse Gases in Climate Variations and Associated Impacts, Villach, Austria, October 9, 1985, WCP/ID1087.

The Villach statement led to creation of the Intergovernmental Panel on Climate Change in 1987. That body, functioning through working groups on science, impacts, and response strategies, has laid the foundation for the June 1992 Rio de Janeiro conference. Jack Fitzgerald, *The Intergovernmental Panel on Climate Change: Taking the First Steps Towards A Global Response*, 14 S.ILL. U. L.J. 231 (1990). UN General Assembly resolutions have authorized the work of the conference. 27 U.N. MONTHLY CHRON. 86-87 (March (1990)).

49. These are noted in Martha Ezzard, *Global Warming: National and International Policy Directions*, NAT. RESOURCE L. CENTER NOTES, No. 22, 6 (1991).

50. *Id.*; see also Lakshman D. Guruswamy, *Global Warming: Integrating United States and International Law*, 32 ARIZ. L. REV. 221 (1990).

Deforestation is a factor in global warming because it reduces an important

There are several legal devices which can perform such an active role. Among them are: (a) administrative regulation, (b) tax law, (c) assessing emitters with criminal penalties, and (d) appropriations laws to support scientific research. These and other techniques can be used in various combinations, and also they can be employed with legal strategies intended to adapt to climate change as well as with existing law with which modified climatic conditions will interact. Should such laws be created, enforcement of them would be designed to slow the rate of increase of global warming. Each illustrative approach will be considered separately.

A. Administrative Regulation

The major instance in which there has been administrative regulation of production and consumption of greenhouse gas producing substances is adoption of international and domestic legal rules relating to CFCs and halons. The impetus for such regulation, however, has been concern over their impact on the stratospheric ozone layer rather than their effect on warming. Nonetheless such regulation is a model for rules which would deal with greenhouse gases in general. It is an environmental bonus that CFC regulation has the side effect of limiting one source of climate change.

In the early 1980's, it became clear that significant depletion was taking place in the protective ozone layer over Antarctica. Later data indicates depletion elsewhere.⁵¹ This occur-

carbon sink which cleanses carbon dioxide from the atmosphere. The policies of many nations have led to deforestation. See, e.g., Luiz C.B. Molion, *The Amazonian Forests and Climatic Stability*, 19 THE ECOLOGIST 211 (1989); Robert Repetto, *Deforestation in the Tropics*, 262 SCI. AM. 36 (1990); Louis T. Steyaert et al., *Inadvertent Climatic Change: Investigating the Coincidence of Deforestation, Inadequate Soil Conservation Practices, Soil Erosion, and Disastrous Food Shortages in Northwest Haiti*, Proc. Am. Meter. Soc'y. Seventh Conference on Inadvertent and Planned Weather Modification at Banff, Alberta, Canada 1 (1979). Reforestation has become an international project. Timothy B. Hamlin, *Debt-for-Nature Swaps: A New Strategy for Protecting Environmental Interests in Developing Nations*, 16 ECOLOGY L.Q. 1065 (1989); Oscar A. Sanchez, *For the Globe's Sake, Debt Relief*, N.Y. TIMES, July 14, 1989, at § A, 29; Roger Sedjo, *Forests: A Tool to Moderate Global Warming*, 31 ENV'T 14 (1989).

Low lying island nations are particularly susceptible to rising sea levels which are one predicted consequence of the greenhouse effect. For advocacy of a worldwide effort to prevent such disasters, see Gjerrit P. Hekstra, *Global Warming and Rising Sea Levels: the Policy Implications*, 19 THE ECOLOGIST 4 (1989).

51. J. Barrie Maxwell & Leonard A. Barrie, *Atmospheric and Climatic Change*

rence has been linked to emissions of chlorofluorocarbons, and it has diminished the high level protection of earth from harmful solar radiation.⁵² Among the adverse impacts of the ozone gap, is increase in skin cancer incidence.⁵³

The need to keep the ozone layer as pristine as possible has resulted in the international community, acting through the United Nations, taking steps toward administrative regulation of CFC production and use. In 1985 the Vienna Convention for the Protection of the Ozone Layer was negotiated. It provided a framework for later negotiations on specific rules.⁵⁴ In 1987 the diplomats reached agreement embodied in the Montreal Protocol.⁵⁵ It placed limits on the consumption and use of chlorofluorocarbons and halons with the objective of reaching a fifty percent reduction in CFCs by 1998 by developed nations.⁵⁶

Until the mid-twentieth century, environmental protection in the United States was left largely to private litigation by plaintiffs complaining of nuisances caused by polluting defendants. It became clear, however, that private legal actions were

in the Arctic and Antarctic, 18 *AMBIO* 42 (1989); Vol. 3 No. 11 *GLOBAL ENVTL. CHANGE REP.* 5 (1991); *Arctic Ozone Hole Is Confirmed but Less Severe Than Antarctic's*, *DESERET NEWS*, March 17, 1990, at A5.

52. William H. Brune, *Stratospheric Ozone and the Case Against Chlorofluorocarbons*, 58 *EARTH & MIN. SCI.* 57 (1989); *OZONE DEPLETION GREENHOUSE GASES, AND CLIMATE CHANGE* (Rep. Comm. on Global Change, Nat'l Res. Council 1989); *Stratospheric Ozone Depletion: Hearing on H.R. 2699 Before the Subcomm. on Health & the Env't of the Comm. on Energy & Comm.*, 101st Cong., 2nd Sess. (1990). See also Glenn M. Mattei, Comment, *Chlorofluorocarbon and Its Effects on the Ozone Layer: Is Legislation Sufficient to Protect the Environment?*, 19 *N.C. CENT. L.J.* 88 (1990).

53. See *Deadly Skin Cancer Rises as Ozone Layer Thins*, *DESERET NEWS*, Mar. 27, 1990, at A7; see also Robert Engelman, *Melanoma Rising: "Catching Rays" Continues to be Risky Business*, *CHI. TRIB.*, Aug. 19, 1990, at Travel, 9.

54. TREATY DOC. NO. 99-9, 99th Cong., 1st Sess. 2 (1985), reprinted in 26 *I.L.M.* 1529 (1987). The United States ratified the convention on August 29, 1986. *Treaties*, DEP'T STATE BULL., Nov. 1986, at 88.

55. TREATY DOC. NO. 100-10, 100th Cong., 1st Sess. 1 (1987), reprinted in 26 *I.L.M.* 1550 (1987). The United States ratified the protocol on April 21, 1988. *Treaties*, DEP'T STATE BULL., June 1988, at 68. For discussion of international ozone regulation, see John W. Kindt & Samuel P. Menefee, *The Vexing Problem of Ozone Depletion in International Environmental Law and Policy*, 24 *TEX. INT'L L.J.* 261 (1989); Orval E. Nangle, *Stratospheric Ozone: United States Regulation of Chlorofluorocarbons*, 16 *B.C. ENVTL AFF. L. REV.* 531 (1989); C. Patrick Turley, Comment, *Ozone Depletion: International Protective Strategies and Implications*, 12 *U. ARK. LITTLE ROCK L.J.* 301 (1990). See also Peter M. Morrisette, *The Evolution of Policy Responses to Stratospheric Ozone Depletion*, 29 *NAT. RESOURCES J.* 793 (1989).

56. Ozone Convention, art. 2 (4).

of themselves insufficient to stem the pollution tide.⁵⁷ The federal government intervened in the form of administrative regulation through passing laws delegating power to agencies such as the Environmental Protection Agency.⁵⁸ Legislative goals for clean air⁵⁹ and clean water were set;⁶⁰ federal standards were established;⁶¹ and the states, as their roles in the partnership with the national government were developed, established state implementation plans to meet the standards.⁶² The administrative regulations governing emissions grew out of the combination of the goals, standards, and plans.⁶³ With respect to air pollution, the 1970 Clean Air Act was the first major federal step.⁶⁴ The 1990 Clean Air Act was the most recent one.⁶⁵

The 1990 federal air quality law, established the present legislative basis for CFC regulation in the United States.⁶⁶ It is the American response to the Montreal Protocol. It provides for monitoring production and international trade in ozone-

57. For discussion of common law environmental remedies, see FINDLEY, *supra* note 3, at 60-66; PLATER, *supra* note 3, at 121-42, 171-223. The notion that private remedies still have a significant role is expressed in Barry R. Furrow, *Governing Science: Public Risks and Private Remedies*, 131 U. PA. L. REV. 1403 (1983).

In addition to climatic change and ozone depletion, acid rain presents a significant challenge to national and international regulation. Here also common law responses have not proven adequate. See Scott M. Matheson, *Uncertainty and Risk: A Public Policy Approach to Acid Rain*, 6 J. ENERGY L. & POL'Y 297 (1985).

58. For a short history of the Environmental Protection Agency and an introduction to its structure, see BONINE, *supra* note 3, at 251-54.

59. 42 U.S.C.A. §§ 7401-7671q (Supp. 1991). Implementation of the statute is analyzed in FINDLEY, *supra* note 57, at 66-97; Squillace, *supra* note 4.

60. 33 U.S.C.A. §§ 1251-1387 (Supp. 1991).

61. See, e.g., 42 U.S.C.A. § 7409 (Supp. 1991) (establishing ambient air standards).

62. State implementation plans are required under 42 U.S.C.A. § 7410 (Supp. 1991). Approved plans are set forth in the Code of Federal Regulations. See, e.g., 40 C.F.R. §§ 52.50-.62 (Alabama); 52.320 *et seq.* (Colorado) (1991). State implementation plans are discussed in ROGER W. FINDLEY & DANIEL A. FARBER, *ENVIRONMENTAL LAW: CASES AND MATERIALS* 295-345 (2d ed. 1985).

63. For analysis of the propriety and effectiveness of this mix, see David Schoenbrod, *Goals Statutes or Rules Statutes: The Case of the Clean Air Act*, 30 UCLA L. REV. 740 (1983).

64. For a history of the involvement of the federal government in air pollution control, see FINDLEY, *supra* note 57, at 68-71.

65. Pub. L. 101-549, 104 Stat. 2684 (1990). For discussions of the impact of the 1990 law, see Leslie F. Chard, III, *The 1990 Clean Air Act Amendments: Section 102 Comes of Age*, 59 U. CIN. L. REV. 1253 (1991); Julie L. Edelson, *A Win for Clean Air*, 8 THE ENV'T'L F. 10 (1991); Pamela B. Levinson, *Cleaning Up Our Act*, 9 DEL. B.F. 26 (1991).

66. 42 U.S.C.A. §§ 7671-7671q (Supp. 1991).

depleting substances;⁶⁷ it establishes a schedule, consistent with the Montreal Protocol, for phasing out production and consumption of CFCs;⁶⁸ it prohibits persons who are servicing, maintaining, or disposing of appliances from venting CFCs into the atmosphere after July 1, 1992;⁶⁹ and it encourages development of safer alternative refrigerants.⁷⁰ The 1990 statute also requires federal studies dealing with methane sources and controls.⁷¹ These studies could lead to legislation directly aimed at climate change.

Interests whose activities are restricted by administrative rules quite naturally resist regulation. Foot dragging by motor vehicle manufacturers is a case in point. Initially automobile exhaust emissions standards were established at levels lower than technology could meet. The standards were intended to prod scientific development; they were technology-forcing. Pleading impossibility of performance, the industry was able to secure successive postponements and scale downs of harsh measures.⁷² Coal combustion regulation faces an even sterner task. At least one manufacturer, however, has announced voluntary termination of CFC production.⁷³

Regulating activities which are precursors to global warming will not necessarily bring to pass the results sought. Air quality regulation has not kept the pace its advocates sought.⁷⁴ This can be attributed partly to inherent flaws in administrative regulation as a means of pollution control. Among the suggested infirmities in administrative government are capture of the regulators by the industries and groups whose activities they have sought to influence, bureaucratization of the process, standardized dealing with situations which are not similar, a resulting need for variances which will correct misfittings on the strict side but not necessarily on the lenient side, inadequate or slanted information coming primarily from entities being regulated, discrimination against facili-

67. *Id.* at § 7671b.

68. *Id.* at §§ 7671c-7671e.

69. *Id.* at § 7671g (c).

70. *Id.* at § 7671k.

71. Pub. L. 101-549 § 603 (1990), reprinted at, SELECTED ENVIRONMENTAL LAW STATUTES 951-52 (1991-92 ed.).

72. PLATER, *supra* note 3, at 760-72.

73. See Kindt, *supra* note 55, at 289; see also John Holusha, *Du Pont to Construct Plants for Ozone-Safe Refrigerant*, N.Y. TIMES, June 23, 1990, § 1, at 31.

74. See *supra*, note 72.

ties depending upon when they were constructed, impacts on technological advance, political intervention, and the cost of operating the regulatory system.⁷⁵ There is no guarantee that administrative regulation to change behavior leading to worldwide climate change will avoid these perils. In fact almost certainly it will succumb at least to some of them.

B. Tax Law

Using governmental tax power is a possible climate change control device. In 1989 the environmental ministers from sixty-eight nations met at Noordwijk, the Netherlands and considered curbing carbon dioxide production. The conference statement proposed stabilization of carbon dioxide emissions by the year 2000. This was a weaker position than several countries advocated.⁷⁶ One of the proposals to reduce emissions was a carbon tax.⁷⁷ This concept was opposed by the United States—after all, we are the Saudi Arabia of coal. But it is a suggestion that has found some favor.⁷⁸

Charging emission fees is familiar to the legal community for the notion is the invention of lawyers and judges. Long before economists had much to say about economic means of controlling pollution, courts were awarding damages against polluters. The risk of being assessed compensatory damages and in some cases punitive damages is a potential cost that every pollution emitter faces. It is a business expense.⁷⁹ It is

75. These reasons for air quality regulatory disappointment are outlined in W. David Slawson, *The Right to Protection from Air Pollution*, 59 S. CAL. L. REV. 672, 718-806 (1986).

76. William R. Moomaw, *Scientific and International Policy Responses to Global Climate Change*, 14 FLETCHER F. OF WORLD AFF. 249, 260 (1990), speaks of the Noordwijk conference.

77. *Id.* Carbon taxes are in place or under consideration in a number of European countries. See *Natural Carbon Taxes: The Countries to Watch*, Vol. 3 No. 12 GLOBAL ENVTL. CHANGE REP. 1 (1991).

There is a federal excise tax in the United States on ozone depleting chemicals. I.R.C. §§ 4681, 4682 (Supp. 1991).

78. The case for environmental quality control through pollution fees and such other economic incentives as marketable emission permits is considered in Bruce A. Ackerman & Richard B. Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171 (1988); Richard B. Stewart, *Controlling Environmental Risks Through Economic Incentives*, 13 COLUM. J. ENVTL. L. 153 (1988); Richard B. Stewart, *Economics, Environment, and the Limits of Legal Control*, 9 HARV. ENVTL. L. REV. 1 (1985).

79. Peter Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277 (1985).

one, though, that can be avoided by taking appropriate care (which has its costs), or by the inability of private claimants to prove such elements of their cases as the causal relationship between their losses and the conduct of the defendants.⁸⁰ Financial manipulation through litigation is not an attractive global warming control strategy because it simply is impossible in the climate change context to prove causation in the classic sense.⁸¹ No one will be charged anything; no one will change their conduct.

Using the tax system as the vehicle for an emissions fee, however, may be regarded as an appealing weapon to combat global warming. Taxes might be employed in varied ways. For example, in the air pollution context, it has been suggested that excise taxes be imposed on production, sales, or use of pollution creating substances, that property taxes be lifted for pollution control equipment, that income tax exemptions, credits, and deductions provide incentives, or that an income surtax be levied to discourage environmental contamination by reducing the profitability of polluting enterprises.⁸² The carbon tax suggested by the underdeveloped nations at Noordwijk fits into this catalog of economic incentives and disincentives.

The principal purpose of taxation is revenue collection. A carbon tax would create a fund which could assist nations whose economies lag behind developed countries. It is a means of transferring wealth from the coal nations—particularly the United States. It is hardly surprising that the transferors do not favor that approach. There is a marked lack of enthusiasm by individuals, groups, and countries for paying taxes.

Information is essential to effective regulation. It also is an important factor in control through taxation. An optimal pollution tax may well produce an efficient amount of externalities. The information needed to produce an optimal tax is, however,

80. The difficulties of proving causation in toxic substances litigation are explored in Troyen A. Brennan, *Causal Chains and Statistical Links: The Role of Scientific Uncertainty in Hazardous-Substance Litigation*, 73 CORNELL L. REV. 469 (1988); Daniel A. Farber, *Toxic Causation*, 71 MINN. L. REV. 1219 (1987).

81. For discussion of non-traditional approaches to the causation question, see Kenneth S. Abraham & Richard A. Merrill, *Scientific Uncertainty in the Courts*, 2 SCI. & TECH. 93, 99-105 (1986).

82. RICHARD B. STEWART & JAMES E. KRIER, ENVIRONMENTAL LAW AND POLICY, 564-87 (1978). In 1991 the government of Ontario announced that it would institute a double excise tax for gas-guzzling vehicles and a tax rebate for fuel efficient cars—"feebates." *Vehicle "Feebates" Become Policy in Ontario*, Vol. 3 No. 3 GLOBAL ENVTL. CHANGE REP. 2 (1991).

"virtually unobtainable."⁸³ Even if assigning a correct price to an activity may be easier than computing the extent of sanctions necessary to change behavior,⁸⁴ taxation as well as regulation requires data and enforcement bureaucracy. Also, given the extent of governmental regulation of energy activities, there is no free market place in which a change such as a carbon tax will impose a monetary surrogate for environmental harm on those nations and groups that are in a position to choose the extent to which they will continue or discontinue such activities.⁸⁵

C. Criminal Sanctions

"Jail time is one cost of doing business that cannot be passed along to the consumer."⁸⁶ It is a powerful incentive for compliance with official commands. Hence, a significant legal development of the 1980s has been the escalating criminalization of environmental misconduct. The "midnight dumper" and his ilk increasingly risk incarceration or criminal fines. The threat of criminal penalties has grasped the business community's attention, and has induced a greater effort to comply with environmental laws.⁸⁷ It is an apocalyptic response to the pollution problem. Criminal penalties as ultimate sanctions for conduct leading to climate change are also an option for legal intervention to cool global warming.

Federal environmental laws in the United States which rely for enforcement on criminalizing unwanted actions target for criminal responsibility conduct engaged in "knowingly."⁸⁸

83. Elizabeth Hoffman & Matthew L. Spitzer, *Experimental Law and Economics: An Introduction*, 85 COLUM. L. REV. 991, 1020 (1985).

84. Robert Cooter, *Prices and Sanctions*, 84 COLUM. L. REV. 1523, 1532-37 (1984).

85. See Ernest L. Edwards et al., *Constitutional and Policy Implications of Louisiana's Proposed Environmental Energy Tax: Political Expediency or Effective Regulation?*, 58 TUL. L. REV. 215 (1983).

86. Paul Thomson, *A New Cost of Business for Environmental Violators*, 7 THE ENVTL. F. 32 (1990).

87. Kevin A. Gaynor, *A System Spinning Out of Control*, 7 THE ENVTL. F. 28 (1990).

For varying views on criminalizing environmental misconduct, see PLATER, *supra* note 3, at 320-56; Steven Ferry, *Hard Times: Criminal Prosecution for Pollution*, 10.4 AMICUS J. 11 (1988); William Goldfarb, *Kepone: A Case Study*, 8 ENVTL. L. 645 (1978); Paul D. Kamenar, *Environmental Protection or Enforcement Overkill?* 7 THE ENVTL. F. 29 (1990); E. Dennis Muchnicki, *Only Criminal Sanctions Can Ensure Public Safety*, 7 THE ENVTL. F. 31 (1990).

88. For a list of such provisions, see Robert A. Milne, Comment, *The Mens*

This somewhat ambiguous description of the required state of mind of miscreants who violate the law has led to an extensive array of case interpretations.⁸⁹ It is an effort to describe the traditional American view of the basis for imposition of criminal sanctions, *mens rea* or a guilty mind. But it can penalize conduct which is merely conscious, but not necessarily purposeful.⁹⁰

Terrorizing individuals and organizations to change their ways is, of course, not always effective. Prohibition⁹¹ may have taught us that criminalizing conduct of the masses does not necessarily reform it. The national speed limit⁹² may have slowed some drivers, but speeding still is endemic. Rousseau put the idea this way: "The first of all laws is to respect the laws: the severity of penalties is only a vain resource, invented by little minds in order to substitute terror for that respect which they have no means of obtaining."⁹³ Attempted slowing global warming through criminal law could well be another "noble experiment."

D. Governmental Funding

One way of "solving" societal problems is "throwing government money at them." Developing technology for coping with greenhouse gas emissions can be encouraged by money subsidies. Public spending can underwrite acquisition and interpretation of data about the complex interactions of causative factors and impacts involved in climate change. The challenges are too daunting to be met by any possible combination of funding sources short of national involvement. Indeed de-horsing this apocalyptic rider will involve an international financial effort.⁹⁴

Spending government money is a matter of law. In the United States there is a two-part process through which public funds are spent. The first step is legal authorization of pro-

Rea Requirements of the Federal Environmental Statutes: Strict Criminal Liability in Substance But Not Form, 37 BUFF. L. REV. 307 (1989).

89. Karen M. Hansen, "Knowing" Environmental Crimes, 16 WM. MITCHELL L. REV. 987 (1990).

90. *Id.*; Milne, *supra* note 88.

91. U.S. CONST., amend. XVIII, repealed by U.S. CONST. amend. XXI, §1.

92. 23 U.S.C. § 154 (1989).

93. Quoted in Eva M. Fromm, *Commanding Respect: Criminal Sanctions for Environmental Crimes*, 21 ST. MARY'S L.J. 821, 822 (1990).

94. See Guruswamy, *supra* note 50.

grams.⁹⁵ They are created by statute and given authorized spending ceilings. But passage of organic laws and spending authorizations does not make money available to programs. It merely puts agencies into the regular government budgeting process. To actually provide funds, it is necessary to enact appropriations laws.⁹⁶ This second step in the government spending process is precious to lawmakers. It is through control over the public purse that the peoples' representatives in democratic countries have checked executive power and protected individual liberties. State governments as well as the national governments follow this two-part spending process.⁹⁷

Congress established the National Climate Program to assist the nation and the world "to understand and respond to natural and man-induced climate processes and their implications."⁹⁸ In 1990 it enacted the Global Change Research Act aimed at planning for and underwriting scientific research and development of technologies useful for reducing energy consumption, encouraging renewable energy sources, developing replacements for CFCs, supporting recycling, and promoting forest conservation.⁹⁹ Adequate appropriations would make these authorizations meaningful.

IV. CONCLUSION

Whether climatic change acts in the context of existing law, is the cause for enacting of legal rules enhancing human adaptation, or is the target of legal efforts to inhibit it, there is need to learn as much as possible about the phenomenon. Science must study "key physical and biological processes such as climate system feedbacks, the detail of the carbon cycle, and interactions between oceans and atmosphere and between the

95. Congress has established procedures and enacted limitations upon its power to authorize programs which would lead to outlays which would exceed the budget. 2 U.S.C.A. §§ 642, 651-53 (Supp. 1991).

96. The Constitution of the United States provides that: "No money shall be drawn from the treasury, but appropriations made by law." U.S. CONST. art. I, § 9. See also EDWARD A. LEHAN, SIMPLIFIED GOVERNMENTAL BUDGETING 8-9 (1981).

97. For comparison of the federal budgeting process with those of the states, see W. Mark Crain & James C. Miller III, *Budget Process and Spending Growth*, 31 WM. & MARY L. REV. 1021 (1990).

98. 15 U.S.C.A. § 2902 (1989).

99. 15 U.S.C.A. § 2931 (Supp. 1991). The program is discussed by Robert W. Corell, *The U.S. Global Change Research Program: An Overview and Perspectives of the FY 1992 Program*, 72 BULL. AM. METEO. SOC'Y 605 (1991).

biosphere and the geophysical parts of the system." More should be learned about the linkages between greenhouse gases and temperature increases.¹⁰⁰

It is recommended that public support should be generated sufficient to defray the costs of the necessary research. Information about global warming in a form useful to them, should be communicated to policy makers as it becomes available. Development should continue of technologies used to reduce greenhouse gas emissions. Policy makers should consider the social and economic consequences of mitigation technologies and strategies. Legal implementation for effectuating policy decisions should be adopted in light of both the effectiveness of the legal strategy and its societal consequences.

The final word about the climate change apocalypse, public policy, and law should be from John's revelation also. "And I saw another angel . . . and he cried with a loud voice . . . Saying, Hurt not the earth, neither the sea, nor the trees . . ." ¹⁰¹ The messenger's admonition can well be directed to our time, and law can be an instrument toward heeding it.

100. Robert M. White, *From Here to Where? Science, Technology, and Climate Negotiations*, 72 BULL. AM. METEO. SOC'Y 377 (1991).

101. *Revelations* 7:2-3.