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FOREWORD: A NEW STYLE OF ECOLOGICAL THINKING IN ENVIRONMENTAL LAW

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It is a truism in policymaking that everything is related to everything else so that, in one sense, all interrelationships and subsequent effects should be taken into account before decisions are made

In the real world of time pressures and staff specialization, the internal links within a policy area are typically explored in great detail But another level, the interconnections between policy areas . . . , is often overlooked.¹

Fundamental “modes of thought” (Denkarten) or “styles of thinking” can be at least as important as ideas or ideologies in shaping the law.² This theory has been pointed out by the distinguished German legal scholar Wolfgang Fikentscher.³ Today, American environmental law is groping toward a new “style of thinking,” as many of the articles in this symposium illustrate.

The need for new ways of looking at environmental law was brought to the forefront a year ago. In a remarkable article, Professor Joseph L. Sax documented the increasing malaise and undercurrent of dissatisfaction with the intellectual underpinnings of environmental law that most

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1. G. SCHULTZ & K. DAM, *ECONOMIC POLICY BEYOND THE HEADLINES* 7 (1977).

2. W. Fikentscher, *Modes of Thought in Law and Justice: A Preliminary Report on a Study in Legal Anthropology* (W. Wuellner ed. 1988) (available at The University of California at Berkeley Center for Hermeneutical Studies).

3. *Id.*

academic practitioners feel.⁴ Professor Sax, of Boalt Hall Law School at the University of California at Berkeley, is one of the academic founders of environmental law.⁵ Sax surveyed every listed instructor of environmental law in the United States and concluded that most professors are "discouraged": "Bewilderment and frustration were the most common themes."⁶ The problem is not merely the growing complexity and detail of environmental statutes and regulations. Instead, according to Sax, "[w]hat discourages law teachers is rather a sense of being drawn into a system in which enormous energy must be expended on something that is ultimately vacuous."⁷

Underlying Sax's complaint is the same phenomenon that provides the occasion for this symposium. It is becoming increasingly clear that we have reached the limits of our current "styles of thought" for analyzing environmental law problems. This article will first describe the characteristics of the current prevailing mode of thinking about environmental law which is termed "goal analysis."⁸ Next, this article explains why goal analysis has reached its limits and now must be transcended. Finally, this article begins to describe the character of a new style of thinking about environmental problems. Several of the articles in this symposium reflect this emerging style, the "ecological approach" to environmental problems.

I. GOAL ANALYSIS AND ITS LIMITS

To understand the current prevailing paradigm of goal analysis and its limits, some background knowledge is necessary. The problem with which environmental law concerns itself is not new.⁹ For centuries property, torts, and nuisance law have struggled with situations in which one person's activities adversely affect his neighbors.¹⁰ To be sure, modern technologies of measurement have made visible many new situations¹¹ in which the ancient tragedy of the commons¹² is played out. However, the model problem with which environmental law concerns itself—the effect of resource externalities on the community (including future genera-

4. See generally Sax, *Environmental Law in the Law School: What We Teach and How We Feel About It*, 19 ENVTL. L. REP. 10251 (1989).

5. See *Most Environmental Law Leaders Shaped Field*, Nat'l L.J., July 23, 1990, at 25-26.

6. Sax, *supra* note 4, at 10251.

7. *Id.*

8. See generally Elliott, *Goal Analysis Versus Institutional Analysis of Toxic Compensation Systems*, 73 GEO. L.J. 1357 (1985).

9. The first smoke control ordinances in England date from about 1300. See generally 1 W. HOLDSWORTH, *A HISTORY OF ENGLISH LAW* (7th ed. 1956).

10. See, e.g., *William Aldred's Case*, 77 Eng. Rep. 816 (1611) (suit for "unhealthy odors" emanating from hogsty next door).

11. For an account of the role of technologies of measurement in prompting government action to deal with environmental problems, see generally Elliott, Ackerman & Millian, *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1 J. L., ECON. & ORG. 313 (1985).

12. See generally Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968).

tions)—is not new.¹³

What distinguishes environmental law from its common law precursors is not the nature of the problems addressed, but rather a changed conception of the role of law and the state in addressing these problems. As Professor Bruce Ackerman has explained, traditionally, the common law was *reactive*. The law concerned itself with evaluating individual transactions retrospectively in terms of conventional moral norms.¹⁴ Thus, *traditionally*, nuisance law asked not whether the benefits of controlling pollution exceeded the costs, but whether an individual's actions were "reasonable" when measured against the conduct of others engaged in similar activities.¹⁵

Environmental law approaches problems involving externalities in the use of resources from the changed jurisprudential perspective characteristic of what Professor Ackerman calls the "activist state."¹⁶ The role of law in the activist state is not merely to apply conventional moral norms. Rather, the law's role in this vision is to use the power of the state prospectively as an instrument for transforming specified aspects of the world. This transformation will allow society to achieve the goals it has set for itself.¹⁷

To date, this vision of environmental law as an instrument to achieve desired social objectives has been implemented through a mode of thought termed "goal analysis."¹⁸ Viewed as a style of thinking, goal analysis posits an isolated, free-standing goal for law to achieve. This goal is usually defined in terms of a single scale (maintenance of air quality standards which protect the public health).¹⁹ The goal is implicitly modelled as a dependent variable that can be manipulated by changing independent variables (legal incentives). Thus, underlying goal analysis is a simple model of causal connections between inputs and outputs, between laws and behavior.²⁰

13. For a fascinating study of how 18th century Japan dealt with these problems, see Totman, *The Forests of Tokugawa Japan*, 18 TRANS. ASIATIC SOC. JAPAN 3D 1 (1983). See generally C. TOTMAN, *THE GREEN ARCHAPELIGO: FORESTRY IN PRE-INDUSTRIAL JAPAN* (1989).

14. B. ACKERMAN, RECONSTRUCTING AMERICAN LAW 38-39 (1984).

15. Ackerman's idealized model of the common law as "reactive" is accurate, if at all, only with regard to *traditional* common law subjects. Under the new style of "activist" thinking, it has also been applied by judges in common law subjects. Cf. Chayes, *The Role of the Judge in Public Law Litigation*, 89 HARV. L. REV. 1281, 1304-16 (1976) (describing new roles for judges). Indeed, one way to conceptualize "the problem" in modern tort law is that judges are applying "activist state" thinking in institutional settings that are not well-suited to this type of analysis. Elliott, *Goal Analysis Versus Institutional Analysis of Toxic Compensation Systems*, 73 GEO. L.J. 1357, 1366-67 (1985). Thus, the *modern* nuisance standard converges with the way environmental law would approach the problem.

16. B. ACKERMAN, *supra* note 14, at 1-5.

17. The view of law as active, as opposed to reactive, can be related to "conservative" as well as liberal goals. See, e.g., Easterbrook, *Foreword: The Court and the Economic System*, 98 HARV. L. REV. 4, 10-12 (1984) (contrasting *ex ante* and *ex post* perspectives on legal issues).

18. See generally Elliott, *supra* note 15.

19. See, e.g., Clean Air Act, 42 U.S.C. § 7409(b)(1) (1977).

20. Professor Robert Ellickson has observed that the conventional model of a direct

More complex versions of goal analysis add side constraints (eliminate adverse health effects to the extent economically and technically feasible) or even instruct decisionmakers to optimize the joint product of several factors (reduce pollution to the maximum extent technically feasible taking into account cost, energy, and other environmental effects).²¹ This type of goal analysis dominates environmental law today, both in the writing of statutes and in our thinking and writing about environmental law problems.

One should not unduly minimize the progress that has been achieved through this type of one-dimensional, goal-oriented environmental law. Even staunch critics of environmental law in the United States must admit that definite, measurable, albeit modest, progress has been made toward achieving societal goals.²² However, as a style of thinking, goal analysis also has definite limits. Many of the articles in this symposium starkly illustrate those limits.

The world in which we live is much more complicated than is assumed by the neat, one-dimensional models of inputs and outputs that implicitly underlie goal analysis as a style of legal thinking. "The law of unintended consequences" holds that interventions intended to affect one variable in a complex system are likely to affect other elements of the system in unforeseen and unintended ways. Most of the articles in this symposium trace examples of how the "law of unintended consequences" produces unforeseen secondary effects. These undesirable effects are often the result of well-meaning interventions taken to achieve laudable environmental goals.

Overarching the specific criticisms various articles in the symposium make is a more fundamental point that goes to the heart of the problem: The way current thinking approaches environmental law is too narrow. As a result, regulatory interventions are prone to produce unintended and undesirable secondary effects. Simplistically, goal analysis assumes direct relationships between inputs and outputs, independent and dependent variables, and legal incentives and desired behavior.²³ That is, the prevailing paradigm of goal analysis is inherently flawed in that the "goals" are artificially defined in abstract isolation. The goals are implemented without regard to the dynamic relationships between goals and other desirable social ends.

As a style of thinking, goal analysis is an adaptation of underlying

relationship between behavior and legal incentives is too simplistic. See generally Ellickson, *Of Coase and Cattle: Dispute Resolution Among Neighbors in Shasta County*, 38 STAN. L. REV. 623 (1986).

21. See, e.g., Clean Air Act, 42 U.S.C. § 7411(h)(1) (1978).

22. B. COMMONER, MAKING PEACE WITH THE PLANET 188-90 (1990). See generally Commoner, *The Failure of the Environmental Effort*, 18 ENVTL. L. REV. 10195 (1988).

23. For a statement of the currently conventional view that internalizing costs of pollution will result in predictable alterations in corporate behavior, see Babich, *Understanding the New Era in Environmental Law*, 41 S.C.L. REV. 733, 749-762 (1990). See also Michelman, *Pollution as a Tort*, 80 YALE L.J. 647, 666-83 (1971) (review of Dean Calabresi's *THE COSTS OF ACCIDENTS*).

metaphors drawn from Newtonian physics and the scientific method as described by Francis Bacon.²⁴ These theories suggest focusing on variations in a single factor while holding other factors constant.²⁵ These styles of thinking are not wrong. They are powerful oversimplifications that can be highly useful *provided* that they are applied to situations in which the interactions among the elements of complex systems are of such small importance that they may be disregarded as essentially nonexistent.

When a toy ball rolls down an inclined plane, not only does the earth's gravity affect the ball, the ball also asserts a gravitational pull on the earth. However, the force of the ball's gravity is so insignificant that it can be disregarded. Therefore, we get into the habit of thinking that the ball's gravity does not exist. Model causal connections also are viewed as if they were direct relationships between independent and dependent variables rather than dynamic interactions among interrelated elements. The Newtonian/Baconian simplification works if, *but only if*, more complex interactions among elements of the system are so trivial that they may be disregarded.

Perhaps environmental law met this test of insignificance in the beginning. As environmental law has become more and more significant, however, the distorting "gravitational pull" which it exerts on economic and social decisions is no longer insignificant. The Environmental Protection Agency's (the EPA) economists estimate that this year in the United States private and public sectors are spending more than \$90 billion per year (in 1986 dollars) for pollution control. By the year 2000, this cost will grow to about \$155 billion annually (also in 1986 dollars), or about 2.7% of our total gross national product.²⁶ According to some private economists, proposed initiatives to address possible changes in the global climate could add to this already impressive total of environmental spending. Additional costs of \$0.8 to \$3.6 *trillion* could be incurred in combatting the climate problem. In the United States, the direct costs could be of the same magnitude as current defense spending. Losses of annual output as high as \$500 billion, or about 5% of national income, are a distinct possibility.²⁷

Far from being trivial or insignificant, world-wide environmental law may be the most ambitious attempt ever by human beings to use law to shift resources and alter behavior.

24. For an exploration of how metaphors drawn from other disciplines affect legal thinking, see Elliott, *The Evolutionary Tradition in Jurisprudence*, 85 COLUM. L. REV. 38 (1985).

25. See generally F. BACON, *NOVUM ORGANUM* (T. Fowler trans. 1878).

26. Address by William K. Reilly, National Press Club meeting, "Aiming Before We Shoot: The 'Quiet Revolution' in Environmental Policy" 6 (Sept. 26, 1990) (summarizing results of the EPA's forthcoming *Cost of Clean* report).

27. Passell, *Economic Watch: Staggering Cost is Foreseen to Curb Warming of Earth*, N.Y. Times, Nov. 19, 1989, at A1, col. 5.

II. THE EMERGING NEW THINKING

In a provocative book, Robert Orstein and Paul Ehrlich argue that nothing less than a fundamental transformation in the nature of human thinking will be necessary if human beings are to take control of their destinies and successfully manage their own evolution and the evolution of their planet.²⁸ The essence of Orstein and Ehrlich's argument is that the evolutionary heritage of humans has programmed into the species a tendency to perceive and monitor sudden changes as single variables in the environment. They argue that in order to effectively manage the global environment, the human species must learn to perceive and think in terms of subtle changes in the interactions of large systems.

By suggesting that the articles in this symposium exemplify an emerging new style of thinking about environmental law, I do not mean to suggest that a transformation is either currently complete or entirely successful. The articles in this symposium illustrate an important first step, but only a first step, by tracing undesirable and unintended secondary effects of environmental policies. Some articles move beyond mere criticism to suggest ways to achieve goals without the identified negative effects. The remaining challenge is taking the more fundamental step of developing a general, theoretical approach to thinking about environmental problems that avoids the types of unforeseen consequences discussed so eloquently in this symposium. The following observations may suggest directions that could prove productive in pursuing that elusive goal.

As George Schultz and Kenneth Dam observed in the passage quoted in the epigraph, in theory it might be desirable to trace all the secondary effects of proposed policies before implementation. Following Professor Mashaw, this ideal of comprehensive analysis is called the "synoptic approach."²⁹ However attractive comprehensive analysis may be in theory, in practice it remains impossible for any individual or organization to think of every possible result before acting.³⁰ Perhaps at some point in the near future, computerized econometric models could make it much more feasible to analyze the secondary incentive effects of major environmental and other regulatory policies. Until these techniques are further developed and refined, comprehensive, prospective analysis of the secondary incentive effects of regulatory policies remains a dream.

A simpler, more practical mode of pre-implementation analysis of proposed policies is cost-benefit analysis. Comparing costs and benefits is the staple of regulatory analysis conducted under the auspices of the Office of Information and Regulatory Affairs (OIRA) of the Office of Man-

28. See R. ORSKIN & P. EHRLICH, *NEW WORLD NEW MIND: MOVING TOWARD CONSCIOUS EVOLUTION* 189-204 (1989).

29. See generally Diver, *Policy Making Paradigms in Administrative Law*, 95 HARV. L. REV. 303 (1981).

30. See generally H. SIMON, *ADMINISTRATIVE BEHAVIOR: A STUDY OF DECISION-MAKING PROCESSES IN ADMINISTRATIVE ORGANIZATIONS* (1976) (emphasizing limited capacity of both individuals and organizations to process information).

agement and Budget (OMB) under Executive Order 12,291.³¹ Secondary misallocations of resources resulting from unforeseen effects of regulations are "costs" of regulatory programs. In theory, these costs ought to be analyzed under Executive Order 12,291. For practical reasons relating to the limits of currently available techniques, however, these secondary costs are rarely identified or taken into account.

A more promising, albeit "rough and ready," approach to avoiding unforeseen secondary effects of proposed environmental regulations would rely on the method of heuristics rather than algorithms.³² Rather than completely analyzing the effects of proposed policies, simpler "rules of thumb" should be used to lead to policies for environmental regulation less likely to result in undesirable and incomprehensible perturbations in the behavior of complex economic and social systems.³³ For reasons that will become apparent, this approach to designing environmental policies is called the "ecological approach."

Underlying an ecological approach to designing regulatory policies is the theory of co-evolution. Co-evolution posits the theory that organisms evolve together with their environments in mutually dynamic relationships so that each is adapted to the other.³⁴ This theory provides an insight into the nature of the evolution of complex, interconnected systems that is familiar to environmentalists in other contexts. For example, environmentalists from Rachael Carson³⁵ to Barry Commoner³⁶ have viewed synthetic chemical pesticides with great suspicion. They prefer natural, biological methods of pest control instead. One reason frequently cited for such suspicion is that evolution has not had time to develop processes for breaking down synthetic chemicals as opposed to naturally-occurring substances. Whether this conclusion is justified or overstated may be sci-

31. See generally Olson, *The Quiet Shift of Power: Office of Management and Budget Supervision of Environmental Protection Agency Rulemaking Under Executive Order 12,291*, 4 VA. J. NAT. RESOURCES L. 1 (1984). Unlike Olson, I am generally supportive of the process prescribed by Executive Order 12,291. See generally *Agency Autonomy and the Unitary Executive*, 68 WASHINGTON U.L.Q. 495 (1990) (panel discussion among Judge Stephen Breyer, Prof. E. Donald Elliott, Judge Laurence Silberman, and former Justice Department official Terry Eastland at Federalist Society Symposium entitled "The President and Congress: Constitutionally Shared and Separated Powers," Washington, D.C., Jan. 19, 1990). I do agree with Olson that public disclosure and fair, regular procedures are essential if the Office of Management and Budget's role in making policy is to be credible and acceptable.

32. On the role of heuristics in simplifying analysis of complex problems, see Tversky & Kahneman *Judgement Under Uncertainty: Heuristics and Biases*, in D. KAHNEMAN, P. SLOVIC & A. TVERSKY, *JUDGEMENT UNDER UNCERTAINTY, HEURISTICS AND BIASES* 3 (1982).

33. While the primary focus of this symposium is on environmental regulation effect on the economic system, elsewhere I am exploring the effects that the design of environmental regulation may have on social values. E.D. Elliott, *The Intellectual Foundations of Environmental Law in the U.S.: From Law and Economics to Law and Biology?* (Columbia Univ. Law School Legal Theory Workshop, Working Paper, February 12, 1990).

34. For a summary of the insights of ecology, including an introduction to the theory of co-evolution, see P. EHRLICH, *THE MACHINERY OF NATURE* 208-23 (1986).

35. R. CARSON, *SILENT SPRING* 205-08 (1969).

36. B. COMMONER, *MAKING PEACE WITH THE PLANET* 50-51 (1990).

entifically debatable.³⁷ For present purposes, that is beside the point. There is an underlying heuristic notion that natural systems are more likely to be perturbed by the introduction of alien materials as opposed to materials to which the systems are already adapted. This is undoubtedly a sound rule of thumb.

The "ecological approach" to minimizing the undesirable secondary effects of environmental regulation builds on this basic insight from the ecology of natural systems. The approach then adapts this insight into the realm of the economy and other social systems.³⁸ The economic environment in which corporate entities function is less likely to be unpredictable in destabilizing ways if government intervenes using methods with which economic entities are already familiar.

The "ecological approach" counsels strongly in favor of relying on information and market-based economic incentives as methods of achieving environmental protection where possible.³⁹ In contrast, the old style command-and-control regulation often implemented outright bans of certain types of transactions or behaviors. The "corporate entities" which are the subjects of this symposium are used to dealing with changes in factor prices and new information coming into the marketplace. These are regular features of the economic environments to which corporate entities are adapted. Consequently, governmental interventions that take the form of these economic changes are less likely to produce undesirable secondary consequences than the less subtle, more directive prohibitions of command-and-control regulation.

There is already a strong and growing body of academic support for the use of market-based systems as techniques for controlling pollution.⁴⁰ However, to date this literature has focused primarily on the claim that market-based systems can achieve levels of pollution control comparable to those achieved by command-and-control systems at a reduced cost.⁴¹

37. See Ames, Magaw & Gold, *Ranking Possible Carcinogenic Hazards*, 236 SCIENCE 271, 276-77 (1987).

38. See generally H. SIMON, SCIENCE OF THE ARTIFICIAL (1969) (promoting basic view that "artificial systems" constructed by humans follow some of same principles of systems theory as natural systems).

39. My own preference is for "hybrid" systems which combine market-based incentives with standard-setting to insure that minimum health-based standards are not sacrificed for economic considerations. Cf. S. KELMAN, WHAT PRICE INCENTIVES 28-83 (1981); G. CALABRESI & P. BOBBITT, TRAGIC CHOICES, 147-91 (1978) (describing ethical dilemmas raised by putting a price on life and health).

40. See, e.g., Administrative Conference of the United States, Providing Economic Incentives in Environmental Regulation (Apr. 23, 1990); Ackerman & Stewart, *Reforming Environmental Law: The Democratic Case for Market Incentives*, 13 COLUM. J. ENVTL. L. 171, 178-88 (1988).

41. See, e.g., Ackerman & Stewart, *Reforming Environmental Law*, 37 STAN. L. REV. 1333, 1341 (1985); Stewart, *Economics, Environment, and the Limits of Legal Control*, 9 HARV. ENVTL. L. REV. 1, 20-21 (1985). The conventional conclusion that market-based approaches necessarily achieve lesser cost solutions has recently been questioned in an important article. See Oates, Portney, & McGartland, *The Net Benefits of Incentive-Based Regulation: A Case Study of Environmental Standard Setting*, 79 AM. ECON. REV. 1233, 1240-42 (1989). The argument by Oates and others relies heavily on the assumption that

One author has even suggested that the limited information and limited analytical capacity that is available to humans argues against market-based systems. These systems are further alleged to be a kind of "fine-tuning" of regulation.⁴² This article suggests that the opposite results when the possibility of unforeseen consequences and secondary effects are taken into account. To minimize unforeseen, undesirable secondary effects of environmental regulation, market-based methods should be used whenever possible.

There is a strong and growing consensus that the next generation of environmental protection will be about preventing pollution rather than merely installing end-of-the-pipe technology to clean it up once it is generated.⁴³ However, a critical debate is ongoing about whether the regulatory techniques used to prevent pollution will be the highly prescriptive ones inherited from our command-and-control heritage,⁴⁴ or "kinder, gentler" market-based incentives. The experience of the last decade has shown repeatedly that stark legal interventions such as precluding particular types of transactions or behavior may have unforeseen and often unpredictable effects. For example, banning one hazardous product may actually increase environmental risks if the substitutes that replace it are less safe.⁴⁵ Alternatively, placing a tax or fee on particularly hazardous materials will, over time, discourage its use with far less risk of disrupting essential activities.

In the final analysis, the appeal of environmental protection is not only technical, but also moral. In many ways, the environmental protection movement is the most ambitious movement ever to use law consciously to redirect human behavior. The goal is to redesign human activities so that they are more in tune with the fundamental order of nature and can be carried out on a sustainable basis. That mission undeniably presents a very demanding challenge to both legal institutions and legal thinking. Unless society develops new ways of thinking about environmental protection, it cannot hope to achieve goals as ambitious as those it has already set for itself.

command-and-control regimes will produce over-control that will result in net benefits. For any level of control desired, however, an optimal mix of controls among sources can be achieved in theory by either market-based or centralized command-and-control systems. In practice, it is much more likely to be approximated by a decentralized system which relies on markets rather than Soviet-style central planning. Stewart, *supra* note 41, at 21.

42. Latin, *Ideal Versus Real Regulatory Efficiency: Implementation of Uniform Standards and "Fine Tuning" Regulatory Reform*, 37 STAN. L. REV. 1267, 1314 (1985).

43. Compare Address by William K. Reilly, National Press Club meeting, "Aiming Before We Shoot: The 'Quiet Revolution' in Environmental Policy" 6 (Sept. 26, 1990) with COMMONER, *supra* note 36, at 213-14.

44. COMMONER, *supra* note 36, at 45, 204 (arguing in favor of banning hazardous substances such as PCB's). See also *id.* at 191-210 (arguing in favor of government-mandated "re-direction" of investment and "re-design" of technologies).

45. See, e.g., Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277, 320-23 (1985) (citing examples of situations where prohibition of one hazardous substance has increased pollution through substitute products).

