BOOK REVIEW

THE UNCERTAIN SEARCH FOR ENVIRONMENTAL QUALITY. By Bruce A. Ackerman, Susan Rose-Ackerman, James W. Sawyer, Jr., and Dale W. Henderson. New York: The Free Press, 1974. Pp. x, 386. $13.95.

Wallace E. Oates†

The growing concern with environmental protection has manifested itself in both the natural and social sciences in a concerted research effort to extend our understanding of ecological systems and to employ this knowledge in the design of policies for an improved environment. Biologists and chemists have labored, for example, to learn the dynamics of the processes of decay and assimilation of waterborne wastes in streams and rivers; at the same time, economists have turned their tools of applied welfare economics to the evaluation of policy alternatives for the preservation of water quality.

While all this is certainly commendable in itself, the trouble has been that the analyses forthcoming from these efforts have taken a highly technical form. The description of river dynamics (a "materials balance analysis") typically takes the form of a highly complex set of simultaneous differential equations. Likewise, the economist's "cost-benefit analysis" draws on a substantial set of often-implicit assumptions as well as extensive quantitative studies. Simply to understand the character of these analyses *and their limitations* requires considerable expertise.

How, then, can policy-makers, who are not technical experts, evaluate such analyses and incorporate them in an intelligent way into actual policy proposals? This, incidentally, is not simply a matter of following the prescription of an able technical adviser, for there are typically important value judgments and individual interests at stake; technical assistance is obviously important, but it is not the whole of the decision.

In addition to making technical analyses comprehensible, there is the closely related and crucial matter of the actual use of such analyses in the process of debate leading to the formulation

† Professor of Economics, Princeton University.

of an environmental program. How, for example, are these studies likely to influence not only the choice of method to achieve the environmental targets but also the selection of the objectives themselves? In short, the issue is how technical analysis itself interacts with the other elements of the decision process.

As a corollary to these problems of technical inputs, how can we design political institutions whose structure will embody the right sorts of incentives for environmental decisions? It is the rule rather than the exception that the natural boundaries for environmental control (water basins and air sheds) do not coincide with existing political jurisdictions. Is it enough simply to ensure that the decisionmaking authority includes representatives from the concerned states and federal agencies?

A recent interdisciplinary study centered at the University of Pennsylvania has produced a profoundly important exploration of these issues in terms of a detailed, thorough examination of the decisionmaking process that resulted in a major and costly program to clean up the Delaware River. The result is, in my view, the most significant book[1] yet written on the determination of environmental policy. The study, under the direction of Bruce Ackerman, is an example of what interdisciplinary research ought to be. Drawing on the technical expertise of natural scientists, economists, and lawyers, the Ackerman group undertook a painstaking three-and-a-half-year effort to understand the roles and interaction of those individuals, both scientists and politicians, whose influence came to bear on the choice of the Delaware program. The book is a fascinating description of this decisionmaking process along with a careful and judicious attempt to ascertain the lessons to be learned from the Delaware experience.

It is this second facet of the Ackerman study that yields something far more then merely an absorbing case study. At appropriate junctures, the authors step back from their analysis of the Delaware decision to consider what of a more generic nature can be gleaned from the proceedings.[2] And it is here that they can generate a series of insights into environmental decisionmaking that transcends the problems of the Delaware Estuary. The reader comes away from the book with a far deeper understanding of the complexities inherent in the application of

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[1] B. ACKERMAN, S. ROSE-ACKERMAN, J. SAWYER, JR. & D. HENDERSON, THE UNCERTAIN SEARCH FOR ENVIRONMENTAL POLICY (1974) (hereinafter cited as B. ACKERMAN).

[2] *Id.* 67-78, 136-61, 208-20.

cost-benefit analysis and of the limitations of the much heralded "co-operative federalism" in resolving our environmental problems, an understanding greatly enhanced by "seeing" these techniques in action in the Delaware program.

To organize the discussion in this Review, I first describe briefly the institutional structure and proceedings for the Delaware enterprise.[3] With this as background, I subsequently turn to three fundamental issues: the use of formal "modeling" and of cost-benefit analysis to define and evaluate the policy alternatives,[4] the significance of the institutional structure for the choice and implementation of programs,[5] and the selection of a form of regulation of polluters to achieve the designated standards for environmental quality.[6]

I. THE INSTITUTIONAL STRUCTURE OF THE DELAWARE PROGRAM

The principal actors in the Delaware drama composed two distinct groups. The first was an essentially technical staff supported by the federal Public Health Service to undertake an ambitious scientific analysis: the Delaware Estuary Comprehensive Study (DECS). Greatly intrigued by the appearance of cost-benefit analytical techniques in Washington in the early 1960's, the Public Health Service saw in the Delaware case an opportunity to push these new techniques into the field of water quality. In 1962 the Service launched, at a cost of $1.2 million, the four-year DECS enterprise with the research under the direction of a young sanitary engineer, Robert Thomann, who had recently completed a doctoral thesis involving mathematical modeling of the effects of pollutants on estuaries. The DECS staff was eager to show how such scientific techniques could form the basis for decisions on water quality in an actual estuary.[7]

In contrast to the research-oriented DECS, there existed at the same time a decisionmaking body, the Delaware River Basin Commission (DRBC). Created in 1961, the DRBC was a new "model regional agency" with a constituency from the four interested states (Pennsylvania, New Jersey, New York, and Delaware) and the federal government. The Commission itself took an innovative form of "co-operative federalism": a regional body

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[3] Text accompanying notes 7-16 *infra*.

[4] Text accompanying notes 17-61 *infra*.

[5] Text accompanying notes 62-83 *infra*.

[6] Text accompanying notes 84-111 *infra*.

[7] B. ACKERMAN, *supra* note 1, at 12-13.

representing the interests of the concerned states and the federal government and endowed with broad decisionmaking powers for the development of the resources of the Delaware River. Moreover, the voting members of the DRBC were not obscure figures; they consisted of the governors of these four states and the Secretary of the Interior.[8]

The origin of both the DECS and the DRBC can be traced to a series of disastrous floods in the Delaware during the 1950's. These pointed up the need for a concerted effort for flood control of the Delaware's waters. This concern, however, soon expanded into a wider undertaking to investigate and control not only water quantity, but also its quality.[9] This enlarged perspective received, moreover, a powerful impetus from the passage of the Federal Water Quality Act of 1965;[10] the Act required the states to submit by June 30, 1967, a set of water quality standards and plans for implementation.[11]

The new federal Act also ushered in a new relationship between the DECS and the DRBC. The Commission faced the difficult task of formulating a set of objectives and programs for water quality in the Delaware, but did not as yet possess an adequate technical staff or research effort to provide a sound and intellectually respectable foundation for such decisions. The DECS staff, however, was well along its way in the development of an operational model of the estuary to be accompanied by estimates of the costs and benefits of alternative water quality objectives.[12] The DECS clearly had what the DRBC needed.

To assist the Commission with its decisions, the DECS staff undertook to produce a preliminary report by mid-1966. This report summarized five potential water quality programs with varying objectives; using a cost-benefit analysis, the staff went on to estimate in dollar terms the benefits and costs associated with each objective set.[13] I have reproduced these estimates as Table I.

What must be emphasized is that it was this set of choices summarized in Table I that came to be the frame of reference for the debate over the Delaware program. When the deliberations began among groups of concerned citizens, polluters, and

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[8] *Id.* 3-5.
[9] *Id.* 11-12.
[10] 33 U.S.C. § 466 (1970).
[11] *Id.*; B. ACKERMAN, *supra* note 1, at 13.
[12] B. ACKERMAN, *supra* note 1, at 13.
[13] *Id.* 14.

TABLE I

COST-BENEFIT ANALYSIS OF DECS POLLUTION PLANS[14]

Objective Set	Cost	High Estimate-Low Estimate of Benefits
I	$490 million	$355-155 million
II	275 "	320-135 "
III	155 "	310-125 "
IV	110 "	280-115 "
V	30 "	—

the DRBC itself, attention was focused on *which* of the DECS objectives was the most appropriate.[15] In the end, the DRBC adopted a slightly modified version of Objective II[16] (which, incidentially, is considerably more ambitious than Objective IV, which produces the largest expected *net* benefit according to the DECS estimates). Important as the final choice may be, it is of far greater significance that *the technical staff of the DECS effectively defined the alternatives*. Just why this is so critical will become apparent in the next section, where we examine what lies behind the figures in Table I.

II. "MODELING" AND COST-BENEFIT ANALYSIS IN POLICY FORMULATION

The DECS staff had first to confront what is basically a definitional issue: the meaning (in measurable terms) of water quality. Opting for a widely used measure, the staff essentially chose the level of dissolved oxygen (DO) to serve as its "proxy" for water quality. In fact, the objective sets cited in Table I effectively represent differing levels of DO; Table II indicates this correspondence.[17]

The first issue this raises is the adequacy of DO as a measure of water quality. The DO content of a body of water certainly is of some significance: If, for example, the DO level "sags" suffi-

[14] *Id.* 15.

[15] *See generally id.* 13-14.

[16] *See id.* 187. *See generally id.* 170-207.

[17] Although the various objective sets did include goals for a number of other pollutants, the DECS staff never considered the costs of reaching any of these "secondary" goals independently of the DO objective. Letter from Susan Rose-Ackerman to Wallace E. Oates, July 20, 1975.

ciently low for an extended period, the waters can no longer support fish life.[18] Moreover, should DO levels approach zero, a noxious process of "anaerobic decomposition" sets in with a vile discoloration of the waters and foul odors.[19] This vitiates any recreational uses (or aesthetic value) of the river or lake.

TABLE II

AVERAGE DO IN PARTS PER MILLION IN MOST POLLUTED AREA OF THE DELAWARE[20]

Objective Set	Level of DO
I	4.5
II	4.0
III	3.0
IV	2.5
V	1.0

To prevent dissolved oxygen from falling to undesirably low levels, a river authority can undertake a number of measures. Most basic, however, is the control of the quantity and quality of those wastes that utilize oxygen in the process of decomposition; the oxygen consumption made by such wastes is typically measured in terms of its Biochemical Oxygen Demand (BOD).[21] Programs to increase DO levels thus entail both reductions in organic wastes and treatment of such wastes to reduce the BOD emissions into the receiving waters.

While the DO level represents one important dimension of water quality, it is by no means the only significant characteristic. For example, another aspect of pollutants that poses an obvious threat is the toxic properties of certain inorganic wastes which can themselves render the water unsafe for drinking, swimming, or fishlife.[22] In short, a certain DO content may be *necessary* to support fish and for certain recreational uses of the water, but it is not *sufficient*.

[18] *Id.* 18.

[19] *Id.* 18-19.

[20] *See id.* 32.

[21] *See id.* 18-22. More precisely, the BOD of a waste discharge is the number of pounds of oxygen that will be consumed in the biochemical oxidation of the organic impurity present in the emission.

[22] *Id.* 27.

Moreover, the authors point out some particular characteristics of the Delaware estuary that create considerable uncertainty about the gains from a program to increase levels of DO. One problem concerns the high levels of river turbidity, which give the water an opaque brown appearance with adverse aesthetic and recreational consequences.[23] It is not clear that a DO "cleanup" would have much effect on the turbidity; but if it did, the clearer water might well prove far more receptive to the growth of algae so that in the end it "may simply mean that the valley is trading a brown river for a green one."[24]

In addition, the sludge deposits in the bottom of the Delaware support a large population of oxygen-consuming worms ("tubificid"). As DO levels increase, the authorities can expect a rapid multiplication of these worms with the associated rise in the "benthic oxygen demand" on the river's supply of oxygen.[25] The extent of these side effects is uncertain; the point, however, is that the ecology of a river like the Delaware is highly complex, and programs to alter one characteristic of the system are likely to have some additional and unexpected effects on other forms of water life.

Suppose that we push all this aside and accept, for the moment, the adequacy of dissolved oxygen as a measure of water quality for the Delaware. How well does the DECS model describe and predict DO levels in the Delaware estuary? The answer is, only moderately well at best. It must first be recognized that DO content is not a single number. The Delaware Estuary stretches about one hundred miles from Trenton to Liston's Point on the coast,[26] and its DO level exhibits wide variations over different spans of its flow. Rather than one level of DO, the oxygen content of the river is described by a "profile" which exhibits graphically the existing DO concentrations at each point along the river. Such a profile indicates a "sag" in DO immediately below Trenton which becomes even more accentuated downstream from Philadelphia. This, of course, reflects the decomposition of the relatively heavy waste emissions from both industrial sources and municipal waste treatment plants in these two areas of concentrated populations and industrial activity. To analyze DO levels, the DECS staff divided the river below Trenton into thirty sections; the DECS model thus aimed at describ-

[23] *Id.* 26.
[24] *Id.* 27.
[25] *Id.* 22, 51-53.
[26] *Cf. id.* 23-24.

ing and predicting DO concentrations in each of these thirty stretches of the river.[27]

This is no easy task. The levels of DO depend not only on the quantities and quality of the wastes emitted at various points along the Delaware, but they are also crucially dependent on the level of the water flows,[28] on water temperatures,[29] and on wind velocities above the river surface.[30] DO is typically at its lowest levels during the hot summer months when the capacity of the river to assimilate waste discharges is at its minimum.[31] Moreover, the water flows are complicated by the fact that the Delaware is an estuary and thus subject to influences from the ocean tides; BOD can flow upstream as well as downstream.[32] Finally, during periods of heavy rain, the sewer systems of Trenton, Camden, Philadelphia, and Wilmington tend to overflow, pouring huge and unpredictable quantities of BOD into the Delaware; these overflows take place about ten days each year.[33]

To keep the problem relatively simple and to reduce data requirements, the DECS staff chose essentially to ignore all these sources of variation over time and to assume a "steady state" condition;[34] that is, they assumed that "*relevant river conditions remained constant over time*."[35] This is obviously a major simplification, but the critical question is the extent to which this assumption impaired the precision of the model's predictions.

Ackerman and his colleagues looked carefully at the performance of the DECS model and found substantial inaccuracies. In about one case out of three, the predicted DO content for a given sector of the Delaware differed from the actual level of DO by more than .5 parts per million.[36] This is not a minor imprecision, as a look at Table II indicates that this can represent the difference between one objective set and another at costs of possibly over one hundred million dollars.[37]

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[27] *See id.* 22-25.
[28] *Id.* 35.
[29] *Id.* 38.
[30] *Id.* 49-51.
[31] *Id.* 38.
[32] *Id.* 33-34.
[33] *Id.* 42-45.
[34] *Id.* 37-39.
[35] *Id.* 37 (emphasis in original).
[36] *See id.* 57-58.
[37] If Objective Set I is chosen, for example, the cost will exceed that of Objective Set II by $215 million, *see* Table I *supra*; yet with a possible DO error of .5 parts per

Moreover, this appears to understate to some extent the full disparities between "actual" and "predicted" values of DO, for the DECS staff had itself previously adjusted some of the predictions in the light of excessive deviations from actual DO concentrations.[38]

All this is not meant to understate the accomplishments of the DECS. The construction of an operational model of the Delaware represents a substantial achievement. The margins of error in the model's predictions, however, appear quite considerable, and this expected divergence of predicted from actual DO levels is a matter that the decisionmaking body should weigh with care. We shall return to this shortly.[39]

The next step in the DECS analysis was to estimate the potential benefits from increased levels of DO and the costs necessary to achieve these improvements in water quality. At this juncture, the staff turned to the economist's technique of cost-benefit analysis,[40] an approach with a substantial history in the evaluation of water resource projects.

A cost-benefit study involves essentially four steps. The first is simply an enumeration of the various forms of benefits and costs inherent in the undertaking. In the case of the Delaware, the "tangible" benefits from a cleanup of the river were determined to consist primarily of an improved recreational potential: swimming, boating, and fishing.[41] To achieve these benefits, it would be necessary to reduce levels of waste discharges into the river with consequent higher costs to polluters who would have to adopt more expensive alternatives in order to reduce the quantity and/or improve the quality of their waste emissions. The costs of the Delaware program were thus primarily the additional expense in cutting back on wastes and increasing the levels of treatment.

The second step is the assignment of actual dollar values to the various forms of benefits and costs. The DECS staff undertook an extensive questionnaire study of the forty-four major polluters along the Delaware estuary to collect information for the estimation of the costs of reduced BOD emissions.[42] At the

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million we have no guarantee that the DO level will exceed that available under the rejected Objective Set II, *see* Table II *supra*.

[38] B. ACKERMAN, *supra* note 1, at 59-61.

[39] Text accompanying notes 54-55, 59-60 *infra*.

[40] For a comprehensive treatment of cost-benefit analysis, see E. MISHAN, COST-BENEFIT ANALYSIS: AN INFORMAL INTRODUCTION (2d ed. 1974).

[41] B. ACKERMAN, *supra* note 1, at 102.

[42] *Id.* 85-86.

same time, a range of estimates was made for the benefits from expanded recreational uses.[43]

The third step involves the selection of an appropriate rate of discount for the evaluation of benefits and costs that are expected to accrue in future years. The point is, simply, that 100 dollars in benefits or costs one year hence is worth less than 100 dollars at the present moment; with positive rates of return (interest), 100 dollars today is worth 100 dollars *plus* the accrued interest at some future date. If, for example, we adopt a discount rate of six percent, we are effectively saying that we will assign a "present discounted value" of 100 dollars to a sum of benefits (or costs) of 106 dollars to be realized one year in the future. The final step in the cost-benefit study is simply to take our time profile of dollar benefits and costs along with the chosen rate of discount and then to calculate the present discounted value of the entire expected future stream of benefits and of costs. These are the numbers presented in Table I above, where the DECS staff used a discount rate of three percent.

Although the general cost-benefit approach seems quite straightforward, there are in fact a number of problems or ambiguities, both in principle and in practice. There are effectively two sets of issues at stake. The first is the assumptions inherent in the cost-benefit technique itself, and the second is the particular procedures employed by the DECS staff to reach the estimates of the benefits and costs of the selected set of objectives for the Delaware. I will comment only briefly on these two matters, for the most fascinating dimension of the book goes beyond the content of the DECS cost-benefit study to the *way* in which the study was employed in the decision process.

The authors set out carefully and lucidly for the nonspecialist the nature of cost-benefit analysis.[44] In particular, it is important to recognize just what the cost-benefit test is. In computing the value of the benefits and costs associated with a particular project, the assignment is determined upon the basis of people's "willingness to pay." The cost-benefit test is effectively an attempt to apply market criteria to the evaluation of public projects. When the researcher calculates and compares the present discounted value of the expected future stream of benefits with that of costs, he is asking the question: Does the value of the undertaking, *as measured by what people would be willing to pay*,

[43] *Id.* 102-03.

[44] *Id.* 104-09. *See generally* E. MISHAN, *supra* note 40.

exceed (or, alternatively, fall short of) its costs, again measured in terms of actual or imputed market prices? The cost-benefit test is thus an analogue to the profit test in the market place, for it measures whether, in principle, there could be sufficient revenues (if people were to pay for the benefits) to cover costs.

Seen from this perspective, we can determine what a cost-benefit test does *and does not* tell us. It does not, for example, indicate to whom the benefits accrue or who bears the costs; it is an aggregative test in the sense that benefits and costs are summed over all persons. This immediately suggests that although the cost-benefit test may supply some valuable information, it is not in itself the sole criterion on which to base project decisions.

Environmentalists, in particular, have raised a second objection to the application of the cost-benefit approach: its exclusively anthropomorphic perspective.[45] The benefits and costs that enter the calculations are the valuations to human beings. But should not some weight be given to the shad or other wildlife whose well-being is at stake? Does man have the right to destroy animals for his own purposes? This involves some tricky philosophical issues—in the end, for example, men will make the decision and it must, therefore, be men's valuation of the interests of wildlife that is relevant. Nevertheless, one can still argue that man has certain responsibilities or interests regarding the "integrity of nature" that extend beyond the scope of conventional cost-benefit calculations.

In addition to these matters of principle, Ackerman and his colleagues explore carefully the specifics of the DRBC cost-benefit study. Here again they find a number of important anomalies and, in some instances, outright errors. From the outset, the DECS staff carried over all the simplifications in the Delaware model to the cost-benefit calculations; the computations, for example, refer only to the attainment of alternative levels of dissolved oxygen.[46] The valuations of benefits and costs are thus themselves subject to all the reservations cited earlier in this section.

Moreover, the authors find that the DECS estimates of the costs of pollution control were far too low, while (largely because of a conceptual error) the benefits appear somewhat exaggerated. In particular, an underestimate of costs resulted, first from

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[45] *See* B. ACKERMAN, *supra* note 1, at 138-42.

[46] Thus the benefits are expressed as correlates for DO Objective Sets I-IV, *compare id.* 103, at Table 4 *with id.* 15, at Table 1, *id.* 32, at Table 2, *and id.* 63, at Table 3.

restricting the study to the forty-four major point-source polluters who account for about two-thirds of BOD emissions[47] and, second, from an inadequate provision for the growth in emissions over time.[48] Some later revised estimates of the costs of dealing with anticipated increases in wasteloads pushed the price from 20 million to 140 million dollars; by this time, however, certain commitments had been made on the basis of earlier estimates, and officials apparently were quick to suppress these new and potentially embarrassing cost overruns.[49]

On the benefit side, the DECS calculations were based on existing estimates of the "intrinsic" value (in dollar terms) of a day of fishing, boating, or swimming, multiplied by a predicted number of users.[50] This measure of benefits, however, is highly misleading; the cost-benefit analyst seeks to measure the value of the new facilities in terms of what consumers would be willing to pay rather than do without them. This implies that the benefits from the new recreational opportunities must be evaluated relative to already existing facilities. The proper basis for valuation is not one of the intrinsic worth of a day of fishing, but rather the value to fishermen of having the Delaware available in addition to existing fishing sites.[51] This methodological bungle (for which, incidentally, there is considerable precedent)[52] probably imparts a substantial upward bias to the DECS estimates of benefits.

With this as background, we can now turn to the most fascinating part of the Delaware story: the way in which the DECS cost-benefit study figured in the deliberations on and ultimate choice of the Delaware program. The preceding paragraphs indicate the substantial degree of imprecision and uncertainty inherent in the DECS estimates of the benefits from and costs of a cleanup of the Delaware; the sweeping, simplifying assumptions and the limited availability of critical information suggest that the findings should be couched in terms of a number of qualifications and warnings. But this is precisely the opposite of what happened. In their eagerness to impress the outside world with their accomplishment in constructing an operational model of the Delaware and using this model to derive actual dollar estimates of the benefits and costs of various programs, the DECS

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[47] *Id.* 85-86.

[48] *Id.* 86-90.

[49] *Id.* 94-96.

[50] *See generally id.* 124-32.

[51] *See id.* 115-19. *See also id.* 109-15.

[52] Mack & Meyers, *Outdoor Recreation*, in MEASURING BENEFITS OF GOVERNMENT INVESTMENTS 71-116 (R. Dorfman ed. 1965).

staff produced a report that hardly even hinted at the imprecision inherent in the predictions of the model and the associated estimates of benefits and costs.

> In short, the basic failing of the DECS Report was not so much that it failed to achieve a degree of comprehensiveness and exactitude that is never achieved outside the most fantastic science fiction; what was seriously defective was the manner in which the DECS Report understood the very idea of "achievement." The DECS succeeded insofar as it developed a set of equations defining a system that accurately described a small piece of reality. Thus, in emphasizing its achievement, the research staff emphasized the accuracy of the numbers its model generated. While this may be fine in a scientific forum in which the findings will be scrutinized by other experts concerned with the development of truth within a single disciplinary speciality, it is nothing short of disastrous when the same attitude is transposed into the policy-making arena.[53]

More basic is the effect the DECS study had on the actual deliberations and the ultimate decision. As noted above,[54] the DECS findings, summarized in Tables I and II, for all practical purposes defined the alternatives. The debate among both interested citizens and the DRBC amounted to haggling over the appropriate objective set from these tables; in short, the DECS effectively channeled the discussion into a consideration of the proper level of dissolved oxygen.

This is enormously important, for it means that, from the outset, public discussion took the narrowest of perspectives. In the view of the authors, the real questions of strategy for an environmental program were eclipsed by the DECS report; Ackerman and his colleagues argue quite persuasively that the likely benefits from the costly Delaware program will be miniscule:

> It is easy to imagine that when society decides to spend almost three quarters of a billion dollars to clean up a 40-mile stretch of river, something significant will come of it. The mind rebels at the thought that such vast sums are spent in vain. Yet in 1978, or 1980 or 1984, when the DRBC announces that it has "suc-

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[53] B. ACKERMAN, *supra* note 1, at 65-66.

[54] Text accompanying note 15 *supra*.

> ceeded" in achieving its DO objectives on the river, the Delaware will be just as cloudy as it ever was; it will be just as difficult to obtain access to the river; boating will be neither better nor worse than it was; the drinking water will taste the same as it always did. *Perhaps* good fishing will be a few minutes closer, and during some years more shad will "survive" their journey up and down the river. Is this what all the talk about improving "the quality of life" amounts to?[55]

The authors contend that primary attention ought to be "focussed on the discharge of exotic chemicals and heavy metals which may pose a real risk to human health when present in drinking water or in seafood";[56] the first priority here is the avoidance of ecological catastrophe. Yet this seemed to have generated little concern among the DECS staff.[57] As to environmental protection generally, Ackerman and his colleagues see little to be gained from extensive and costly efforts to rehabilitate heavily used water systems; instead, they argue that the general strategy should be to preserve those resources as yet relatively unspoiled by twentieth-century life.[58] Rather than attempting at great expense to raise the level of DO in the Delaware around Trenton and Philadelphia, we would do better to preserve the lower estuary from the incursion of sources of pollution.

Whether or not they are correct on this basic issue of environmental strategy, it is striking that in the course of the Delaware deliberations this matter was never even acknowledged![59] The force of the DECS preliminary report was such as to sidetrack the discussion from a consideration of the real alternatives to a relatively trivial controversy over whether the DO level would be brought to 2.5 or 3.0 parts per million. And the ultimate outcome may well be, as the authors suggest,[60] an extremely expensive program with little noticeable effect on the quality of the Delaware's waters.

What are we to conclude from all this? It seems to me that a reader's first reactions may be of two general kinds. One may conclude that the real trouble rests in the DECS analysis; if the technical staff had simply adopted a broader perspective on the

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[55] B. ACKERMAN, *supra* note 1, at 142 (emphasis in original).
[56] *Id.* 145.
[57] *Cf. id.* (noting DRBC and general national inattention to poisons discharges).
[58] *E.g., id.* 137, 140, 144-45.
[59] *See generally, e.g., id.* 145.
[60] Text accompanying note 55 *supra*.

environmental alternatives and at least made clear the basic qualifications to their findings, we might have expected a far more enlightened public discussion and a more informed choice of a Delaware program. In short, what was needed was a better Delaware model and cost-benefit study. One may, on the other hand, take a more pessimistic stance and reason that such analyses are likely to be more misleading than helpful, that we would do better to give up attempts aimed at "sophisticated" definitions of the problem and at quantification and leave the decision to the judgment of the responsible bureaucrats and elected officials.

Neither of these reactions, however, seems to me the proper inference. It is too easy simply to put all the blame on the DECS study. There were obviously a multitude of serious deficiencies in the analysis *and* in its presentation, and we could certainly look to improved analytical studies to provide a better foundation for public debate. But even if the technical work is of a high quality, there remains the very formidable problem of its transmission in a usable form to decisionmakers. In particular, the nature of analytical studies and the needs of the political decisionmaker seem to verge on incompatibility: Analysis involves simplification which in turn implies important qualifications to any findings, while the political participant is seeking a position or decision he can take without fundamental ambiguities. I do not want to suggest that this is an insurmountable obstacle: We have, for example, benefited greatly from the use of analytical work in determining macro-economic policy. The tension (and the compromises) between the informational needs of the political process and the tentative character of analytical findings and predictions, however, surely exists.

Conversely, it really does not make much sense to abandon analytical studies of policy alternatives. As the authors put it,

> When confronted with this precis, the reader is doubtless tempted to conclude that the DECS exercise, when properly understood, contributed nothing of value to a more precise understanding of the problems confronting the sensitive decision maker. But this would be a mistake; for it is only as a result of our effort to trace the DECS' investigations that it has been possible to obtain a perspective on the probable consequences of the costly program of pollution control which the DRBC has adopted. Our basic complaint does not go to the wisdom of the effort at sustained understanding of

> river dynamics but to the way in which the DECS staff chose to *translate their insights into language comprehensible to decision makers*.[61]

Where this discussion leads is not to the abolition of policy analysis but rather to a study of institutional structure. The basic issue is the formation of a set of decision procedures that, first, will pose the proper questions, and, second, will generate and bring to bear the relevant kinds of information and analysis. It is to this matter of institutional structure that we turn next.

III. The Design of Institutions for Policy Decisions

The Delaware experience also represents an innovative venture in "cooperative federalism." Not only was the decisionmaking body, the DRBC, composed of prestigious representatives from both the federal government and the concerned states, but federally supported technical assistance from the DECS staff provided, as we have seen, the basic research capability for the undertaking. How well did this institutional structure fulfill its role?

The authors have grave reservations about the division of the research and decision functions between the DECS (the "thinkers") and the DRBC (the "doers").[62] The problem is best seen by considering the incentives confronting each agency and following through the likely implications. From the standpoint of the federally supported DECS, the basic enterprise was one of implementing *and* selling a highly complex and sophisticated form of environmental analysis. For the staff of the DECS, the Delaware study presented an opportunity to demonstrate the effectiveness of an innovative technique. With this perspective, such a "pure thinking agency may be expected . . . to justify its existence by overselling the accuracy and importance of its preliminary reports by underemphasizing the uncertainties underlying its predictions."[63]

Moreover, the "thinking agency" is unlikely to have a long-term commitment to the program. The DECS staff would realize the bulk of their returns in the short run from the establishment of a basic analytical framework and from the initial results, not from the longer and more mundane efforts to accumulate basic and improved data and to follow up and refine the results.[64]

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[61] B. Ackerman, *supra* note 1, at 64 (emphasis in original).

[62] The authors so label the two agencies, *e.g.*, *id.* 74.

[63] *Id.* 74.

[64] *Id.* 74; *cf.* text accompanying note 7 *supra*.

In contrast, the orientation of the "action agency" is toward the implementation of a program. This agency, in our case the DRBC, typically requires the assistance of a technical body of some sort to help in the formulation of the program and to provide a kind of intellectual respectability.[65] But once the fundamental program is outlined, the action agency, like the thinking agency, is interested in selling the program, not in pointing up existing uncertainties or qualifications;[66] the decisionmakers can thus be expected to reinforce the tendencies of the research group to stress the precision and reliability of the plan. Moreover, once the action agency has implemented the program, its concern will be primarily with the enforcement of the plan, rather than with continuing basic research aimed at future planning efforts.[67] This bifurcation of responsibility appears to discourage follow-through on the basic planning efforts.

The DECS and DRBC seem to have followed this pattern of behavior quite closely. I have already stressed the exaggerated level of precision in the DECS reports.[68] In addition, the research effort apparently lost most of its vitality following the publication of the DECS preliminary report in 1966. The preliminary report promised a definitive "final document" by the end of 1967, a document which has yet to be published.[69] With the completion of the preliminary report, there was a shift of the basic research and planning function from the federally supported staff to the regional level.[70] Although there was much additional work to be done in extending the DECS model and developing a more comprehensive and reliable data base, little seems to have followed on the preliminary report. In fact, the data-collection effort is at present so sporadic and generally inadequate as to preclude further effective research aimed at improving the predictive capability of the model.[71]

From this experience, Ackerman and his colleagues conclude that

> The course of events along the Delaware eloquently warns against placing the federal "thinkers" in one bureaucratic box, then shifting the responsibility for

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[65] *Cf.* B. ACKERMAN, *supra* note 1, at 74-75.
[66] *Id.* 75.
[67] *Id.*
[68] *Cf.* text accompanying notes 26-38 *supra*.
[69] B. ACKERMAN, *supra* note 1, at 68-69.
[70] *Id.* 69.
[71] *See id.* 69-73.

> scientific follow-through to the regional "decision-making" agency, simultaneously consigning the task of data gathering to yet another set of state agencies. In such a structure each component is prone to lose sight of the function it should be performing to enhance the rationality of the pollution control scheme that is the ultimate product of all the sound and fury.[72]

The implication of all this would seem to be that the decisionmaking agency should have within its own organization the basic research capability. This too presents difficulties, however; in particular, the control of the agency's officials over the research personnel may serve to inhibit critical evaluations of existing policies.[73] At least the division of functions in the Delaware provided a certain protection and scope of independence for the DECS staff.

There seems to be no easy resolution of the dilemma. After considering a number of alternatives, the authors propose the creation of a new body: an Environmental Review Board.[74] The Board's function would be to provide an outside, independent assessment of each agency's environmental planning efforts. With a "quasi-judicial independence" from the executive and legislative branches of the government, the Board would scrutinize and evaluate basic environmental plans to ensure that the proper alternatives have in fact been posed *and* that the analysis of the alternatives is sound.[75] In the case of the Delaware, for example, such a Review Board would presumably have required a broadening of the perspective beyond just the DO level of the estuary, as well as the resolution of certain anomalies in the basic model and the cost-benefit analysis. The potential for such a review body is, I think, considerable; our closest relative to the proposed Board has probably been the General Accounting Office (GAO), several of whose reports have been extraordinarily revealing.[76] Simply the existence of such a reviewing agency keeps people on their toes with the knowledge that a shoddy job of analysis may easily be exposed.

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[72] *Id.* 77.

[73] For an account of the conflict between DECS and DRBC, see *id.* 191-93.

[74] *Id.* 156-61.

[75] *Id.* 156-57.

[76] *See, e.g.*, COMPTROLLER GENERAL OF THE UNITED STATES, EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING WATER POLLUTION (1969) (critical review of federal program for subsidizing construction of municipal waste treatment facilities).

Let us turn next to the decisionmaking process in the DRBC itself. Through a lengthy series of interviews with the actual participants in the DRBC decision and a study of associated written documents, the authors found a number of recurring patterns of behavior which again cast considerable doubt on the efficacy of some of the new forms of cooperative federalism. Without trying to recapitulate the positions and roles of the individual Governors, the Secretary of the Interior, and others with some influence in the decision process, let me simply highlight some of these tendencies.[77] The central difficulty stems from the basic and obvious fact that the primary political commitment of each of the participants is to a constituency other than the regional agency itself. The interviews and proceedings made clear that what was uppermost in the minds of each of the members of the DRBC was how best to further his own interests *in terms of his own political jurisdiction*.[78] This meant, among other things, that these extremely busy political figures were able to devote little effort to an understanding of the distinctly regional dimensions of the Delaware problem. They turned for advice to their own political advisors with the result that a truly regional orientation never developed in the DRBC.[79]

It is not surprising that when it came time to take a position on the Delaware program, each participant consulted his own political calculus. As the Delaware experience makes clear, however, the inevitable compromise that emerges from such an amalgamation of varying interests may bear little resemblance to an effective regional program.

> The technocratic-political decision, whatever its ultimate value, requires tight integration among fact finders, analysts, and politicians. In contrast, federalism is instinct with the demand that power be fractionalized among competing groups and levels of government, and the suspicion that a coherent, tightly organized governing structure will by virtue of that single fact possess too much power and so act irresponsibly. Unfortunately, the federalist effort to eliminate the possibility of the abuse of power can often make it impossible to use power intelligently as well.[80]

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[77] For a full discussion of the political maneuvers accompanying the DRBC's adoption of the DECS Objective Set II, see B. ACKERMAN, *supra* note 1, at 170-89.

[78] *See id.* 182-87.

[79] *See id.* 193-200.

[80] *Id.* 189 (footnote omitted).

There is, moreover, no obvious way to resolve this fundamental dilemma of American federalism. One potential response would be the creation of a new layer of government: regional political bodies to address explicitly regional issues. But it is difficult to be sanguine about imposing yet another set of bureaucracies and associated political activities on the American system. The authors explore a number of institutional alternatives and offer several provocative proposals. Their approach is essentially to distinguish among various environmental issues according to the sorts of geographical and institutional demands they make on our public institutions. As they see it, the most promising response would involve some national agencies—a Poison Control Board[81] and a Nature Preservation Trust[82]—along with some regional and perhaps metropolitan units to protect and develop recreational facilities.[83] These proposals, however, are an exploration of various responses to an enormously complex set of issues rather than a definitive blueprint for a set of public institutions for the formulation and implementation of environmental policies.

IV. Legal-Orders versus Regulation by Market Incentives

In the last section of this Review, I want to examine another set of problems with somewhat more economic content: the method of regulating waste emissions. Once the environmental targets are specified, it becomes necessary to design and implement a program to achieve them. In the case of the Delaware Estuary, we have seen that the designated objective was a certain minimum level of dissolved oxygen.[84] To attain this target, the environmental authority faced the problem of allocating emission quotas among polluters so as to restrict waste discharges to a level consistent with the prescribed level of dissolved oxygen.

The authors' analysis of this issue is most illuminating. In principle, there were two broad options available to the DRBC. The first is "regulation through legal orders." This, in fact, has been the traditional approach: The authority issues orders to each of the polluters specifying a limit to his waste emissions and indicating certain penalties if this limit is exceeded.[85] There is,

[81] *See id.* 209-10.
[82] *See id.* 214-15.
[83] *See id.* 210-13.
[84] Text accompanying notes 17-21 *supra.*
[85] *See id.* 225-26.

however, a second general technique for controlling levels of emissions, which the authors call the "market model" of regulation. This approach involves the use of pricing incentives to "ration" the available pollution rights.[86]

Economists have, for many years, been pressing the case for price incentives.[87] And the Delaware experience adds substantial support to this case. The basic appeal of the pricing approach is its potential for achieving the environmental objective at relatively low cost and doing so without making major demands for information or intervention on the part of the regulating authority. In principle, the regulator need only set a price or charge on the BOD content of waste emissions and adjust this charge until polluters cut back waste emissions to the target level.

In addition to its (at least apparent) simplicity, the pricing technique can result in large savings. Suppose, for example, that we have a world of two polluters in which the first can reduce waste emissions at a cost of five cents per pound while the second suffers a cost of twelve cents per pound. To minimize the cost of a reduction in total waste emissions, we would obviously assign the entire cutback to the first polluter, for any cutbacks by polluter number two would involve an "excess" cost of seven cents per pound. Note that this is precisely what would happen under a pricing regime: If, for example, the regulator set a price of six cents per pound, all the reduction in waste emissions would come from the first polluter; the second would pay the charge of six cents per pound and maintain his level of waste discharges.[88] More generally, in a model with many polluters, a single uniform charge will lead to the least-cost pattern of reductions in emissions: Those who can cut back on effluents most cheaply will do so to avoid the charge, while those polluters for whom this is very costly will elect instead to pay the effluent fee.[89]

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[86] *See id.* 226.

[87] This dates at least to A. PIGOU, THE ECONOMICS OF WELFARE (1920). For a sampling of more recent literature, see W. BAUMOL & W. OATES, THE THEORY OF ENVIRONMENTAL POLICY: EXTERNALITIES, PUBLIC OUTLAYS, AND THE QUALITY OF LIFE (1975); A. KNEESE & B. BOWER, MANAGING WATER QUALITY: ECONOMICS, TECHNOLOGY, INSTITUTIONS (1968); Freeman & Haveman, *Clean Rhetoric and Dirty Water*, THE PUBLIC INTEREST, Summer 1972, at 51.

[88] *See* B. ACKERMAN, *supra* note 1, at 260-61.

[89] This is a somewhat oversimplified example. In general, the cost per pound of reduction in emissions will depend on the magnitude of the cutback; this, however, does not impair the generality of the argument since each polluter will reduce his waste discharges to the point where the cost of an *additional* pound's reduction (the marginal cost) equals the effluent fee.

One most interesting output of the DECS mathematical model of the Delaware was a set of estimates of the costs of achieving the various objectives by alternative regulatory techniques. The DECS staff found, for example, that a set of legal orders imposing a uniform percentage reduction on the emissions of all polluters sufficient to achieve the DRBC objective (that is, Objective Set II) would entail an estimated treatment cost of 335 million dollars as compared to a cost-minimizing allocation of reductions of 235 million dollars—an "excess" cost of 100 million dollars![90]

This finding becomes of more than hypothetical significance in the light of the actual course of events. The DRBC elected the traditional regulatory approach: a system of legal orders to all polluters.[91] They were well aware, however, of the cost-minimizing potential of varying the quotas among polluters. In particular, the DRBC sought to realize a large portion of these savings by dividing the eighty-six-mile estuary into four zones and assigning different percentage reductions in wastes for each zone, a "zoned-uniform percentage treatment plan." Once the differences in costs implied by the recommended zonal differentials became clear, however, the DRBC was quick to narrow the variation, presumably in the interests of fairness and consensus, until in June, 1968, they promulgated emission reductions for the four zones of 86.0, 89.25, 88.5, and 87.5 percent.[92] The authors conclude that "the DRBC four-zone scheme was nothing more than a public relations triumph, masking a traditional uniform treatment regime. . . . [T]he retreat [of the DRBC] represents a dramatic example of the difficulty of taking even modest steps toward cost minimization when constrained by the traditional version of the legal orders model."[93]

Even these guidelines proved terribly difficult to implement. The appeal of uniform percentage reductions for all polluters is some notion of fairness or equity based on "equal effort." But uniform percentage reduction from what? Surely a refinery that has already instituted extensive and costly treatment procedures should not be required to reduce its emissions by the same proportion as a neighbor who has been emitting untreated wastes into the river. To deal with this issue, the DRBC staff had to undertake the enormously complex task of determining the

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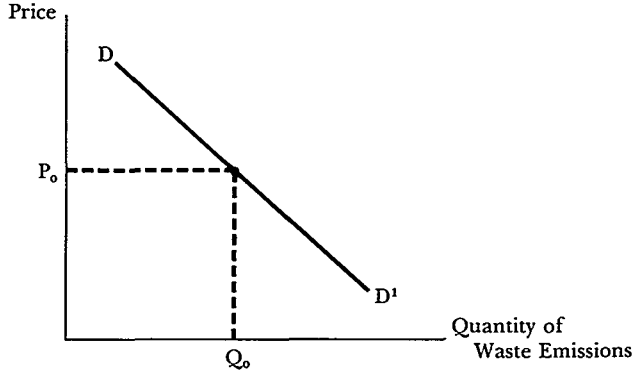
[90] B. ACKERMAN, *supra* note 1, at 230, Table 7.
[91] *Id.* 231.
[92] *Id.* 234-35.
[93] *Id.* 235-36.

hypothetical "raw waste load" for each major polluter to use as a benchmark for determining its pollution quota.[94] The authors document some of the anomalies that emerged in this case-by-case determination.[95] In particular, their Table 8[96] indicates a range of pollution quotas for different refineries (from 692 to 14,400 pounds of BOD per day) that would probably be difficult to reconcile with any reasonable standard of equity. In short, the legal-orders regime produced an allocation of pollution quotas that appears excessively costly and bears little relation to the "equal effort" principle of fairness.

This experience would seem to make the alternative approach of relying on market incentives all the more attractive. Under this general rubric, however, the environmental authority has two further options. The first is the imposition of effluent charges to induce the necessary reductions in waste emissions.[97] The second is the sale or auctioning of "pollution rights."[98] In principle, both lead to the same outcome: With effluent charges, the regulator raises the fee until the target level of emissions is achieved (he sets the price at the level required to realize the desired quantity); under the pollution-rights scheme, the regulator offers for sale emission rights equal in total to the target level (he sets the desired quantity directly and then lets price adjust to the market-clearing level). This is easily seen in Figure I, where DD^1 is the polluters' demand curve for emission rights and Q_o is the target level of waste discharges. Under a system of effluent fees, the environmental authority would establish a

FIGURE I



[94] *Id.* 248-53.
[95] *Id.* 253-57.
[96] *Id.* 254.
[97] *Id.* 260-61.
[98] *Id.* 261.

price of P_0 to which polluters would respond by emitting wastes of Q_0. Alternatively, the authority could simply sell Q_0 of pollution rights for which the market-clearing price would be P_0.

While these two techniques yield the same result in principle, they have some important differences in practice. In particular, the use of effluent charges involves an element of risk and, perhaps, delay that is not inherent in the pollution-rights method. The difficulty is the imprecision in the authority's knowledge of the demand curve: with only rough estimates of the likely response of polluters to differing levels of charges, the regulator may set a fee other than Figure I's P_0, as a result of which either too much or too little pollution (relative to the target Q_0) will occur.[99] Of course, the environmental authority can make subsequent adjustments to the effluent charge in a process that should converge to the target level of emissions, but this may take time.[100] Moreover, continuing adjustments in charges and levels of emissions are costly to firms and other polluters, as well as politically unpopular.[101] In contrast, if the regulator simply sells the targeted quantity of pollution rights, this source of uncertainty and adjustments is eliminated. Since the objective is a specified level of waste emissions, the authority can set this directly by specifying quantity.[102]

In addition, the authors point to the administrative advantages of the pollution-rights technique in the context of a growing economy. Over time, with the expansion of the economy and industrial activity, we can expect the cost of treatment necessary to maintain a specified level of water quality to grow; new plants

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[99] *Id.* 262-63, 265-67.

[100] *Id.* 263.

[101] *Id.* 268.

[102] *Id.* 267. By eliminating the uncertainty regarding the *quantity* of emissions, however, the pollution-rights technique necessarily introduces uncertainty concerning the market-clearing price. This may not, incidentally, be a trivial matter. Suppose, for example, that x pounds of BOD emissions have been offered for sale, but that the issue of 1,000 additional pounds of emission licenses would make possible a substantial saving in abatement expenditure (and perhaps release to society resources that could instead be used to build schools and hospitals) with only a very minimal effect on environmental quality. Then the decision to issue only x (rather than $x + 1{,}000$) pollution rights would have imposed a heavy cost on society, one very likely unforeseen by the environmental authority. The grounds for the choice between the use of fees and the auctioning of pollution rights may then be a matter of which risk constitutes the greater danger. If unanticipated emissions are the most imminent threat to the public welfare, that argues for the auction of rights, which leaves little doubt about the probable volume of pollution. On the other hand, if pressing alternative uses for society's resources mean that excessive outlays on pollution control are a luxury that society can ill afford, then the fees approach, with its firmer control of abatement outlays, may be the preferable procedure.

will appear and the tendency will be toward expanding waste emissions. With a *given* effluent charge, emissions will rise and water quality will deteriorate.

> Of course there is nothing to prevent an aggressive authority from raising the charge whenever this is appropriate. Nevertheless, . . . an effluent fee system will place *the burden of affirmative action* to maintain the agency's original environmental objectives *on nonpolluting river users*. In contrast, under the effluent rights system, the maximum permissible discharge is fixed at the time of the original decision, and the costs of growth will be borne only by polluters who will bid the price of the rights up over time. Thus, the rights system places the *burden of affirmative action on the polluters* to convince the agency that the increasing marginal compliance costs so outweigh the marginal environmental benefits of the status quo that some degradation below current levels should be permitted and additional rights issued.[103]

For these reasons and others, the authors endorse a pollution-rights scheme as the most promising means for controlling waste discharges.[104] While this is by no means a new proposal,[105] it is not (to my knowledge) one that has really been considered very seriously at the policy level, and this is unfortunate. Perhaps this is because the proposal sounds strange: "The auctioning of pollution rights" has an almost otherworldly (Utopian or Satanic) ring.[106] Although unfamiliar, I would suggest that it is quite workable: Once having determined the acceptable level of waste emissions, I see no insuperable barrier to the allocation of quotas by sale rather than by the elaborate, and ultimately unsatisfactory, legal-orders method followed by the DRBC.

For my own tastes, I would be delighted with the introduction of either effluent charges or pollution rights into the pursuit of our environmental objectives. Either technique would represent an enormous improvement over the costly, and often largely ineffective, legal-orders tradition which has dominated

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[103] *Id.* 269-70 (emphasis in original) (footnotes omitted).
[104] *Id.* 281. *But see id.* 275-81.
[105] *See, e.g.*, J. DALES, POLLUTION, PROPERTY, AND VALUES (1968).
[106] *See generally* B. ACKERMAN, *supra* note 1, at 276-78.

environmental policy in this, and most other,[107] countries. While there is mounting evidence that pricing incentives are an efficient *and* highly effective means for controlling water pollution, air pollution, and the generation of solid wastes,[108] there remains a latent hostility to any technique that explicitly recognizes "pollution rights" or the desirability (in view of the costs) of maintaining positive levels of various polluting activities.[109]

I do not want to leave the impression that the authors (or I) see the "market model" as the sole answer to our environmental problems. In fact, one of the most impressive aspects of this study is its painstaking effort to assess both the advantages *and disadvantages* of the various policy alternatives. The market model, if used *alone*, suffers from some serious deficiencies. (For example, there is the problem of coordination: Economies of scale in treatment may dictate the need, in certain instances, for joint planning and use of facilities; but it is not clear that voluntary action on the part of individual polluters will result in the establishment of such facilities in the most advantageous locations.[110] Moreover, some effluents may be so dangerous to human life that their discharge should simply be banned altogether.[111]) The point is rather that a heavy reliance on price incentives should constitute an integral part of an overall environmental strategy. Unfortunately, we have to this point chosen to ignore this potentially powerful instrument for protection of the environment.

V. CONCLUSION

The authors conclude their study on a relatively pessimistic note as regards the formulation and implementation of an effective environmental policy.[112] The Delaware experience not only indicates the deficiencies in a single episode of analysis and decisionmaking, it also reveals a series of extremely complex and troublesome obstacles inherent in the very process of instituting a sensible environmental program. It is clear that we have a

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[107] COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY 348-56 (4th Annual Report 1973).

[108] William Baumol and I are preparing a survey of this evidence to appear as part of our forthcoming book, *Economic Policy for the Quality of Life*.

[109] *See* B. ACKERMAN, *supra* note 1, at 276-78.

[110] *Id.* 282-85.

[111] *See id.* 209-10.

[112] *See id.* 317-30.

great distance yet to travel to our objective of a rational, efficacious policy for the protection of the environment.

What is perhaps most disheartening about this are the recurring lapses in understanding in policy determination in the most critical places. Not long ago, for example, Congress enacted the extensive Federal Water Pollution Control Act Amendments of 1972 with the nonsensical declaration that "it is the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985."[113] Such flights of fancy indicate the pervasive character of certain fundamental misconceptions regarding environmental policy and, in the end, serve to confuse and impede any real progress toward the realization of a reasonable set of environmental objectives. And on the administrative side, we witness such things as the agonizing delays and time extensions to meet emission requirements for new automobiles followed by recent reports of the ineffectiveness of the new emission-control devices. All in all, there is much evidence to support the authors' closing statement:

> What is disappointing, even alarming, is the prospect of government, frustrated by the difficulty of structuring a coherent response, embarking on an urgent quest to achieve a poorly defined goal without institutions present to raise the right questions, and without the regulatory tools to achieve objectives either efficiently or fairly. The environmental revolution of the 1970's suggests that we have yet to learn the lessons of the 1960's. After all these lessons have been mastered, however, we shall only have taken the first step toward a system of government that will permit modern men to live in harmony with themselves and nature.[114]

Yet the limited perspective of the Delaware hides some real progress elsewhere. Regarding air pollution, for example, the last decade has witnessed quite striking reductions in the sulphur and particulate content of the atmosphere over most of our major cities (as well as many cities abroad).[115] And new programs, such as Oregon's requiring deposits for beverage containers, are showing encouraging results for the recycling of

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[113] 33 U.S.C. § 1251(a)(1) (Supp. III, 1973). *See* B. ACKERMAN, *supra* note 1, at 319-25.

[114] B. ACKERMAN, *supra* note 1, at 330.

[115] COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 107, at 273.

solid wastes.[116] In the water resource field itself there is some evidence of reduced waste discharges in response to municipal waste-treatment fees.[117] Progress, however, is slow and difficult; it is the important contribution of this book to help us to understand why this is so and to face up to the basic dilemmas and tradeoffs inherent in the quest for environmental quality.

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[116] D. Waggoner, Oregon's Model Bill, Two Years Later (May 1974).

[117] Elliott & Seagraves, *User Charges as a Means for Pollution Control: The Case of Sewer Surcharges*, 3 BELL J. ECON & MGMT. SCI. 346 (1972).