When Values Conflict

Essays on Environmental Analysis, Discourse, and Decision

Chapter One

Failures of Discourse: Obstacles to the Integration of Environmental Values into Natural Resource Policy*

A Reading of the Controversy Surrounding the Proposed Tocks Island Dam on the Delaware River

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I. ANALYSES ARE NOT ABOUT WHAT PEOPLE CARE ABOUT

Major environmental decisions have a way of getting stuck and staying stuck. The discussions about whether to undertake substantial transformations of natural areas—to bring about new power plants, dams, airports, pipelines, deep water ports—have several pathologies in common. A cluster of detailed technical analyses accompanies the formulation of the program and its initial rush onto the stage; the proponents of the project imply, and generally believe, that all one could reasonably have expected has been done, both to justify the program and to anticipate its pitfalls. As after a carefully planned transplant, the reaction of rejection is slow in coming but grows relentlessly. The analyses are shown to be incomplete, and new analyses starting from different premises are eventually produced by those who wish to stop the program. But, contrary to what one might naively expect, the existence of disparate analyses does not help appreciably to resolve the debate. Rarely are the antagonists proud of their analyses; more rarely still are they moved

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by the analyses of their opponents. The combatants on both sides have been constrained by mandated rules of procedure as well as by the tactics of compromise. Understandably, the politicians in a position to determine the outcome conclude that their time is not well spent pondering the available analyses, even though they may commission still more of them.

The failure of technical studies to assist in the resolution of environmental controversies is part of a larger pattern of failures of discourse in problems that put major societal values at stake. Discussions of goals, of visions of the future, are enormously inhibited. Privately, goals will be talked about readily, as one discovers in even the most casual encounter with any of the participants. But the public debate is cloaked in a formality that excludes a large part of what people most care about.

Analyses are part of the formal debate. We should not be surprised to learn, therefore, that the disciplined analyses brought to bear on a current societal dispute hardly ever do justice to the values at stake. Terribly little is asked of analysis, and analysts respond in a way that allows the potentialities of their disciplines to be undervalued. A recrurrent theme in this and the companion volume is that disciplined analysis has enormous unused capability. My sense is that we need to look much more carefully at the reasons why this capability lies unused. There is a dynamic interaction between the demands made and the tools developed. It is not realistic to expect much refinement in tools to occur in the absence of a contemporaneous evolution in the rules of public discourse.

The land use debate I have most pondered, and the source of most of my generalizations, is the debate over whether to build a major rock-fill dam on the Delaware River at Tocks Island, thereby creating a 37-mile-long lake along the New Jersey-Pennsylvania border. The dam was proposed by the Corps of Engineers and was authorized by Congress in 1962. Although land has been acquired, and the National Park Service has arrived on the scene to administer the Delaware Water Gap National Recreation Area that is intended to surround the lake, construction has not yet begun. It may never begin. The likelihood of construction has diminished considerably during the period of our study (roughly 1972 to 1975). However, there is a well-known asymmetry: One can decide over and over not to build a dam; one only need decide *once* to begin construction, and there it is.

I happen to hope that the dam will not be built. Building the dam, it seems to me, would buttress an attitude of impudence toward our natural resources. Not building the dam, on the other hand, would stimulate the development of alternate technologies, intrinsically more respectful of nature, which are ever more urgently needed. Of all the arguments for and against the dam, this need to stimulate a reorientation of our technology is for me the single most compelling one. This essay, in part, seeks to imagine what a technology responsive to an environmental ethic would look like. The search for such a technology is one of the absent features of current analysis.

Laurence Tribe's essay in this volume is replete with insights into why an attitude of impudence toward natural resources pervades our culture quite generally at this time. His essay launches a parallel, and even more neglected, area of investigation—into how our attitudes are affected by going along with plans for a dam's construction or resisting such plans, by choosing to build or choosing not to build.

Others, who hope that the dam *will* be built, are persuaded by arguments with which current analysis is also unconcerned. There are some who sustain a vivid image of the havoc wrought by floods. They regard the rest of us as their wards, who need to be protected from our faulty memories. They are almost surely right in their assertion that if another flood were to strike the Delaware Valley during the remaining period of debate, those in favor of the dam would have a far easier time prevailing. They may be wrong, however, as to whether a program to limit flood damage ought to concentrate its construction on the river's main stem, instead of on its tributaries. I know of no serious analysis that captures the essence of this particular issue.

Others in favor of the dam resonate to the argument Robert Dorfman finds so compelling in his own essay in this volume: the many poor people in the metropolitan areas not very distant from this project have needs deserving priority in federal programs; one of these needs—getting away—is better matched to lake recreation than to river recreation; the preferences of the environmentalists are those of people just a bit too comfortable with themselves and too self-centered. This, too, is a position strongly held, politically salient, and not, to my knowledge, captured by a single piece of sustained analysis. One possible analysis along these lines would explore the institutional, economic, and social factors relevant to a comparison of recreation at Tocks Island Lake with recreation at improved urban facilities, including swimming pools.

There are a wide variety of reasons why those concerned with affecting the outcome of a major land use issue are not envisioning (or at least are not expressing) many of the concerns that in fact move them and many of the options that in fact are open to them. Given the fact that virtually all the participants are dissatisfied with the way discourse currently proceeds, it seems worthwhile to make a substantial effort to understand some of the underlying reasons for these failures of discourse, and some of the possibilities for averting them.

II. BLUNT TOOLS AND SKEWED DISCOURSE

A. Golden Rules

The decision about whether to build Tocks Island Dam is widely perceived to be a choice among alternative conceptions of the region's future and, at a deeper but still articulated level, among alternative conceptions of man's appropriate relationship to nature. The tools that might have assisted in clarifying what the possible futures entail include cost-benefit analysis, which has been designed to facilitate comparisons between programs offering differing streams of future costs and benefits. Working with these tools, as Henry Rowen argues persuasively in this volume, ought to lead to translations of dimly perceived preferences into relatively explicit strategies, and ought to reveal the incompatibility of some sets of aspirations and the compatibility of others. Current practice, however, follows a series of golden rules—prescriptions and routines that the analyst perceives to be a means of simplifying the tangle of options (and of staying out of trouble), but that prevent the analyst from taking full advantage of the capabilities the tools provide.

The best conceivable use of the tools, to be sure, will leave serious problems unsolved. David Bradford and Harold Feiveson, in an essay on cost-benefit analysis in the companion volume, make the useful three-way distinction among "ideal," "best practicable," and "actual" cost-benefit analyses. The abuse of tools through overuse of golden rules creates a gulf between actual and best practicable analyses, to which I return momentarily. But even best practicable cost-benefit analyses are going to have serious shortcomings, which discussions of ideal cost-benefit analysis have often underestimated. Discussions of the limitations of cost-benefit analysis nearly always emphasize uncertainties about the discount rate and contain caveats about the lack of sensitivity regarding who gets what. Only rarely do they call attention to the problem of drawing a boundary around the system being studied. As in idealized thermodynamics, the cost-benefit theory presupposes a system coupled with its surroundings in such a simple way that one can change the system without perceptibly affecting the surroundings. To do a sensible cost-benefit comparison of two alternative futures, one has to include in the "system" all the activities with which are associated large differences depending on which future is being considered.

If one is to compare a future with the Tocks Island Dam to one without it, even the dollar costs are such that one must include the incremental sewage treatment facilities required to coexist with a lake instead of a river, and the extra roads needed to bring the visitors to the recreation area, if lake-based recreation will indeed attract more visitors than river-based recreation. Both these costs, it turns out, are comparable to the cost of building the dam itself (several hundred million dollars). One may also have to include the uncompensated costs endured by the roughly 20,000 residents in the valley whom the reservoir project is displacing. But then what about including, on the other side of the balance sheet, the increases in property values expected if the dam is built? Does the series of new entries terminate, in the sense that one is finally considering effects (such as gross interregional migration?) that, even though large, are still effectively unchanged by the existence or nonexistence of the project? No analysis has convinced me that the series does terminate or converge in this sense.

Golden rules have been developed which shelter the practitioner of cost-benefit analysis from this uncertainty about boundaries. The analysis becomes stylized, like the folk art of an isolated village. Those costs and benefits which it is permissible to include in the analysis become codified, as do many of the procedures for evaluating their dollar magnitudes. The warping effect on discourse is substantial. It is hard not to introduce the project to a newcomer with: "The project has four intended benefits" (water supply, flood control, recreation, and electric power, in this instance).

The formal rules also carry weight in the detailed planning of a project. The Corps of Engineers continues to maintain that the "highest and best" use of the lake requires the provision of recreation facilities on its shores for 9.4 million visitors (actually, visitor-days) per year, in spite of the statement by two successive governors of New Jersey that they will approve the project only if the recreation facilities are scaled down to 40 percent of that figure. The Corps' persistence must be strongly affected by the way the analyses come out when the formal conventions are followed, for recreation comes to almost half the total annual benefits when the higher figure is used. Others in this volume comment on the extraordinary reduction in the problem's structure that occurs when the value of recreation is calculated by multiplying a fixed dollar value per visitor-day ($1.35) with a number of visitor-days per year, irrespective of who the visitors are, or how crowded the facilities are, or whether the same visitor spends several days or several visitors spend one day.[a] Here I wish to emphasize that these oddly formal rules do have real consequences—consequences such as extra roads being built through open country to provide the access needed to keep the park populated.

The rules of procedure that govern the planning process have yet further impact in restricting the search for alternatives. One of the rules, for example, is that, at a given site, either a multipurpose project or a single-purpose project is to be undertaken—and that, once this choice is made, *multipurpose projects are not to be compared with packages of single-purpose projects addressing the same needs.* Invoking this golden rule, the principal government agencies (the Corps of Engineers and the Delaware River Basin Commission) can dismiss a proposal without analysis if it addresses just one of the four intended benefits—even if another, companion proposal addresses the other three. Environmental critics of the Tocks Island Dam have advocated the use of "high-flow skimming" to provide increments to water supply equivalent to those the dam would produce. If one enlarged an existing reservoir (Round Valley) and perhaps built an additional small reservoir in a subsidiary valley, thus filling the reservoirs with Delaware water in high-flow months and emptying them in low-flow months, offstream storage would be achieved and the main stem of the Delaware would remain unblocked.[b] This suggestion, to be sure, does nothing about main-stem flood control, but flood-plain zoning does. The package needs to be placed alongside the Tocks project. Yet high-flow skimming has been dismissed with a single comment: "This is not a multipurpose project."[c]

[a]The dollar values of alternate forms of recreation *are* distinguished; $1.35 is a weighted average of the forms of recreation Tocks will provide.

[b]The proposal was initially suggested by Smith Freeman, a scientist acting as an interested bystander. It was explored in greater detail in a study commissioned by the Environmental Defense Fund, *New Jersey Water Supply: Alternatives to Tocks Island Reservoir* (M. Disko Associates, W. Orange, N.J., October 1973).

[c]The rule operates in another instance that stacks the deck against packages of single-purpose projects. The water supply benefit is quantified as the dollar cost of the least expensive alternative way of providing an equivalent amount of water, and the cost of building this alternative is calculated using a higher discount rate than the discount rate for the multipurpose project. The grounds for using two different discount rates are that the Corps may not build the single purpose project it is evaluating, and any other builder would have to borrow money at a higher rate of interest. (The rates used are 3-1/8% for Corps projects and 4-1/2% for alternative projects.)

When the routine procedures of a government agency are consistent with the perfunctory rejection of ideas emerging from outside its bureaucracy, "noise" is thereby built into the discourse between that agency and its critics. The environmentalist critics have pushed the idea of high-flow skimming harder (and with more success, perhaps, than the idea deserves), because of the inability of the government agencies involved to look at it squarely.

B. Golden Numbers

Environmental discourse likewise manifests a powerful dependence on numbers. A number that may once have been an effusion of a tentative model evolves into an immutable constraint. Apparently, the need to have precision in the rules of the game is so desperate that administrators seize on numbers (in fact, get legislators to write them into laws) and then carefully forget where they came from. Then *no one* wants to reopen an argument that hinges on one of these golden numbers.

In the Tocks case, one such golden number is 3,000 cubic feet per second (cfs), the target minimum flow for the Delaware as it passes Trenton, New Jersey. During the drought years from 1963 to 1965, the flow at Trenton fell below that value for months. (The minimum recorded daily low flow was 1,240 cfs in July 1965.) This happened largely because New York did not live up to an agreement with New Jersey and Pennsylvania, negotiated by a river master appointed by the Supreme Court,[d] to release water from its own reservoirs on the Delaware tributaries so as to sustain a flow of 1,525 cfs (another golden number) at Montague, New Jersey, a little over 100 miles upstream from Trenton. (Not surprisingly, nearby New York City—half of whose water comes from these reservoirs—had grounds to fear a water shortage in the same months.) The salt concentration in the river near Philadelphia increased as a result of this low flow. The Public Health Service standard for drinking water is 250 parts chloride per million parts of water (still another golden number). During the autumn of 1964, the line in the river where this concentration is found crept to within ten miles of the place (called the Torresdale intake) where Philadelphia takes its water supply out of the Delaware.[e]

[d]Amended Decree of the Supreme Court of the United States Re Delaware River Diversion, 347 U.S. 995 (1954). The 1960s drought exceeded the drought of record (in the 1930s) on the basis of which the original agreements had been quantified.

[e]The Torresdale intake is at mile 110.53, and the mean daily 250 parts per million chloride line was found at approximately mile 101 on Nov. 20, 1964,

Somewhere (no one appears to remember the details) it was decided that "3,000 cfs at Trenton" would give everyone a proper margin of safety. And proposed reservoirs upstream from Trenton are now judged in significant part by their ability to provide enough "low-flow augmentation" to assure that 3,000 cfs at Trenton could be achieved if there were another drought like 1963–66. Without the Tocks Island Dam, under a contemporary rerun of the historic drought (but assuming that New York maintains its obligations and that reservoirs built since the drought are utilized), flows at Trenton that stay above 2,700 cfs could be achieved. But the missing 300 cfs, or 10 percent, causes genuine alarm. Even *one* percent values have policy content. Electric utilities are told to provide offstream storage of cooling water for their planned riverfront power plants, on the basis that the associated evaporative losses from cooling (about 30 cfs for a typical 1,000 megawatt electric generating plant with a cooling tower) threaten the 3,000 cfs guideline. A few government officials and utility executives wonder aloud where the "3,000 cfs" number came from, and what they are hoping for is the instatement of some lower number that experts will say is safe for Philadelphia (and for the wells of Camden, New Jersey, across the river).

But to hallow *any* minimum flow is to skew the discourse. Whenever a ground rule of discussion is that some standard or guideline is to be accepted as an on-off number, above which there is "safety" and below which there is "peril," two vital kinds of discourse become illegitimate: discussions of acceptable damage, and discussions of damage limitation.

C. Acceptable Damage

The apparent thrust of engineering is to protect man and his works from nature's assaults. Bridges are to survive the highest winds, buildings are to stay warm on the coldest days. Dams, especially, are perceived as symbols of security, as protectors from both floods and droughts. "When water is stored behind a dam, it is there when you need it, like money in the bank," an old-timer told me. A dam's aura of invincibility derives, no doubt, from its sheer bulk, its monumentality. Yet the image is a most incomplete one, for the reservoir,

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according to Plate III-1 of *Water Resources Study for Power Systems: Delaware River Basin* (consultants' report prepared by Tippetts-Abbett-McCarthy-Stratton, March 1972). The salinity level falls rapidly with distance in that range of concentrations; it was only 40 ppm at Torresdale on that same (worst) day. The same chloride line at high water slack may have been a mile closer.

which comes along with every dam, is the exemplar of compromise. How high should the reservoir be filled? Too high and a surprise flood will not be contained, too low and the reserve supply will be absent in a drought. From which of the multiple outlets, at varying heights, should water be withdrawn in late summer (when the reservoir is thermally stratified and the deep, cold water is laden with decaying organic matter)? One answer emerges if the goal is to "enhance" the fish life downstream, another if the goal is to remove nutrients that contribute to the eutrophication of the lake; the two goals are unlikely to be perfectly compatible. The hallmark of engineering is the trade-off and the artful compromise.

But people prefer appearance to reality. There is rarely any clamor to make trade-offs explicity; it is enough for many that the compromises reached reflect professional judgment. Public discourse is thus dominated by solutions offered as risk-free. Among his colleagues, an administrator for the Federal Aviation Administration responsible for equipping private airports with traffic control equipment can admit to having a target figure in his head for "acceptable annual fatalities from general aviation operations." And military officers get used to thinking in terms of acceptable losses of troops and materiel. But neither the mayor whose town abuts the airport nor the President preparing the battle plan can use such language with his constituency. The larger the issue of public accountability (as opposed to professional accountability alone) looms in an official's mind, the less willing he becomes even to formulate a problem in terms of acceptable risk. These reflexes persist even when no lives are at stake: thus the desire to find a safe minimum flow so as not to think about tolerable levels of discomfort and dislocation.

Yet the usefulness of phrasing problems in terms of acceptable risk is probably nowhere so obvious as in problems that involve fitting man's activities onto a highly variable natural background. This has been recognized explicitly in some of the air pollution legislation, where standards are typically written in the form: the concentration of pollutant X shall not exceed C_o more than N times each year. The most compelling reason for drawing up probabilistic standards of this sort is to recognize and bend with the variability of atmospheric phenomena; atmospheric inversions, for example, will occur occasionally, with little notice, and will produce a buildup of pollution levels. It may be unreasonable to have so much pollution control equipment in place that on the occasion of the worst inversion on record, the pollution concentration C_o is not exceeded. Put another way, it may be possible to win community acceptance of a C_o that is lower as long as an occasional escape is permitted. Mathematically, having C_o and N to play with instead of just C_o (with N set equal to zero) gives the legislator and the community more options in terms of environmental planning.

The regulation of water use seems not to have manifested the same subtlety of design. Pollution targets are almost invariably set at specific values, rarely even adjusted for the time of the year.[f] Minimum river flows, as specified in rules and procedures without built-in escapes, determine the operation of reservoirs. New reservoirs are judged primarily in terms of their "safe yield." All these simplifications channel the imagination in similar ways. The safe yield of a reservoir is that rate of extraction of water from the reservoir which, under a recurrence of the most severe drought of record, could be sustained continuously. Usually the reservoir, at the extremum of the drought, lies nearly empty.[g] Attention is thus diverted from any consideration of riding with the punch, organizing one's affairs differently when the drought arrives, and leaving the reservoir with most of its water in it.[h]

From the standpoint of public health, there would seem to be no explanation for this distinction between air and water standards. The adverse health effects of air and water pollution are structurally similar: both involve no clear-cut level at which acute reactions ensue, no physiological warning that levels have become toxic, enormous variability among individuals (including certain groups that are especially susceptible), and uncertain synergisms. River flow is an even better example of stochastic (random) variability in nature than are the movements of cold and warm fronts of air. It is perplexing that environmental design reflecting this variability has not arisen. Perhaps the older traditions of water law and the concomitant

[f]For a detailed discussion of the remarkable oversimplification of the structure of the pollution problem in the planning for the cleanup of the Delaware estuary, see Bruce Ackerman, Susan Rose Ackerman, James W. Sawyer, Jr., and Dale W. Henderson, *The Uncertain Search for Environmental Quality* (New York: Free Press, 1974).

[g]If a reservoir is constrained by rules of operation to retain some minimum water level, this is incorporated into the calculation of its yield.

[h]The dissonance between the recreation and water supply objectives of the Tocks reservoir has figured prominently in its political history. In those years when "drawdown" of the reservoir would be necessary, mudflats would be exposed at its periphery and the opportunities for recreation correspondingly impaired. The Council on Environmental Quality has called particular attention to this problem, and to the problem of eutrophication (see section III A), in its reviews of the project.

self-images of the "water professionals" are historically inhibiting factors.

The water professionals make continual use of the stochastic concept of the *N*-year storm, or flood, or drought—one whose severity should be exceeded, on the average, just once in *N* years. The concept is most often used in situations where *N* is large (50 or 100 or more) and a decision is to be made about how high to build a levee or how strong to make a mooring buoy. The concept unfortunately happens to be on least secure scientific footing when *N* is large, because of the shortness and uncertainty of the available hydrological record and the significance of unaccountable changes in topography. The concept is rarely used when *N* is small, say 10. It would be worth searching for a way of activating an interest in procedures where, say, one year in every ten (with the dates determined by nature), the planned interactions of man with river will be qualitatively different. If the river is ordinarily used for waste removal and for commercial fishing, for evaporative cooling and for drinking water, then during the summer and autumn months of a once-in-ten year of unusual low flow, either the wastes will be removed in a different way (or will be more highly treated or stored) or the commercial fishing will be suspended; and either the power production upstream will be cut back (or another form of cooling used) or the drinking water will be taken from somewhere else.

If one is willing to confront the costs of occasional disruption, one is led quite naturally to modify the usual analyses of the optimal timing of construction of water supply projects. When a positive discount rate is used to relate intertemporal preferences, the result, necessarily, is that it pays to delay any project somewhat beyond the time when it would be needed under the (usual) assumption that the historic worst drought will certainly befall the region the very year that the project is completed.[i]

Once acceptable damage becomes a legitimate subject for discourse, much of the fabric of water resource planning must be rewoven. Projects are deferred with a nonzero probability of their arriving too late; reservoir management proceeds under the expecta-

[i]These ideas have been worked out quantitatively, with a highly simplified model of the variable hydrology, in a significant but unpublished Appendix to the Northeastern United States Water Supply Study of the Corps of Engineers, *Economic Analysis for Organization, Legal, and Public Finance Aspects of Regional Water Supply*, 1972. The appendix was prepared by the Institute of Public Administration, New York, N.Y., and, in particular, I believe, by Dr. Ruth Mack.

tion that in low rainfall periods there will be some compromise between drawdown and curtailment of consumption; and consumption is scanned for its lower and higher priority components. The cumulative effect of such a reweaving will be to weaken the insulation of society from natural events. Acceptable damage is disruption of routine at times beyond our choosing: it means brown lawns and fountains empty in droughts, closed highways and downed power lines in floods.

Nature modulating society: is this something we could ever get used to? The thrust of most of industrial society has been in the opposite direction: to reduce man's vulnerability to nature's excesses and, by extension, to reduce man's subordination to nature's variability. The starkest contrast in nature is *dead-alive.* Man has labored hard to be in control of that dichotomy to the largest extent possible; judging from the present concern with the treatment of the terminally ill, man may indeed be overdoing it. But there are lesser contrasts that industrial man has also felt it was his destiny to override, where it is even more certain that we are in sight of a boundary of reasonableness. *Light-dark:* The candle, the electric light, the night shift, the night ball game. *Cold-hot:* Clothing and housing, refrigeration, hothouse fruits and vegetables, air conditioning, heated patios in winter. *Wet-dry:* Boats, dikes, irrigation, umbrellas, humidifiers and dehumidifiers. One could go on—*grass-crabgrass*, overcome by herbicides, *grass-mud*, overcome by artificial turf (and plastic trees!). The shame of a city surprised by an early snowstorm, and of a town faced with a washed-out bridge—might that shame now have become excessive?

The vast majority of us are uncomfortable contemplating even the possibility of deliberately subjecting ourselves to the variability of nature. A representative of the Delaware River Basin Commission finds such a concept "not socially acceptable." Yet, as Charles Frankel and Laurence Tribe make vivid (in two very different ways) in their essays in this volume, the possibility of *success* in insulating ourselves from nature is a horror it is time to confront. Have we indeed instructed the engineers to produce a technology such that no natural event, however rare, would require us to react? Did we really mean to do this?

D. Damage Limitation

When discussion of acceptable damage comes more naturally to the planners, more inventive approaches to *damage limitation* can be expected to follow. In recent years, there has been a start in this direction, promoted in considerable measure by The National

Environmental Policy Act of 1970 (NEPA), which requires the examination of "nonstructural alternatives" to all federally assisted construction programs. The nonstructural alternatives to dams as a means of flood control include flood-plain zoning, carrot-and-stick flood damage insurance, and early warning systems. At least the first of these has figured prominently in the discourse in the State of New Jersey, whose legislature has passed a flood-plain zoning act as a direct result of a chain of argument originating with the proposal for the Tocks Island Dam.

The nonstructural alternatives to dams as a way of extending water supplies include, above all, strategies to improve water conservation, including metering and charging for water in a way which discriminates between consumptive and nonconsumptive uses and between high and low flow periods. Efforts along these lines have begun recently at the Delaware River Basin Commission. Indeed, part of the water resources community regards the Tocks Island Dam as an old-fashioned project precisely because it fails, by and large, to incorporate the currently more fashionable nonstructural approach to the historic objectives of water management.

But damage limitation strategies are by no means limited to nonstructural strategies. There are "engineering strategies" to minimize the damage of droughts and floods, which nonetheless may involve hardware in the cities instead of hardware in the wilderness. The new state buildings in downtown Trenton in the flood plain of the Delaware were built with their heating and cooling plants on higher floors so that flooding could be withstood. One damage limitation strategy for drought periods for Philadelphia might be to run a pipe upstream ten or even twenty miles, so that water could be taken from the Delaware in a region of lower salinity in the event of a severe drought; in normal times, the pipe would just lie there.[j] Another damage limitation strategy—one that would take much longer to implement and that might apply only to a new or rebuilt city—would be to maintain two parallel water systems, one for uses that require high quality water (drinking, cooking, bathing) and one for uses that can tolerate water of lower quality (many industrial uses, toilet flushing). In so doing, a city would substantially reduce the task of producing enough high quality water.[k] All these are

[j]The earliest reference I know that presents this idea is the *Report on the Utilization of the Waters of the Delaware River Basin* (Malcolm Pirnie Engineers—Albright and Friel, September 1950).

[k]An analogous approach to the likely energy problems of the next two decades would seek a means to supply priority users of electrical energy

"structural" or "engineering" solutions; conceivably, the system of parallel piping would be even more complex and costly than a system of dams and reservoirs. The difference, however, lies in the location at which the enterprise is carried out: engineering our urban complexes rather than our wilderness areas and landscapes. Those encouraging the search for nonstructural solutions are largely motivated by a desire to be more gentle to the natural environment; they should be reminded that the same end can often be achieved by a geographic transposition of the technological imagination.

If creative technology should one day return to the cities and there display an increased cybernetic emphasis, we will begin to raise our expectations of the machines around us. We will insist that they last longer, be easier to repair, and undergo a more satisfactory metamorphosis at the end of their lives. We will also learn to insist that our machines report to us more faithfully how they are functioning, so that we know when to repair them or replace them. Finally—and perhaps this is more controversial—we will come to insist that our machines allow us to increase our sensual contact with our natural surroundings.

Of all the impacts of the "energy crisis" of the 1973-74 winter, the most lasting, I predict, will be its impact on architecture. The downtown office building of the 1960s already stands as a metaphor for the whole society's desire for enforced independence from the natural setting: temperature, humidity, air exchange, and lighting are all controlled mechanically, independent of season, wind speed, or whether one is on the north or south side of the building. Neither materials nor design change as the location is moved in latitude by thousands of miles. (In physicists' jargon, the building is invariant under ninety-degree rotations, displacements in space, and translations in time.) The notion of air conditioning a sealed office building on a mild day appears grotesque once one becomes aware that upstream from the power lines there are scarce resources whose extraction and conversion are necessarily accompanied by environmental damage. The office building of the near future will have openable windows, fewer lights and more switches, north-facing walls very different from south-facing walls (the latter having awnings or comparable "soleil briser" projections), and east-facing walls different from west-facing walls if either east or west is the direction of the

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(hospital facilities, refrigerators, elevators) even in situations of substantial brownout or blackout. As a colleague of mine put it, "invest in switching equipment."

prevailing wind. It may also have solar energy collectors and water collectors on the roof and windmills mounted on the vertical edges. Less symmetry, more deliberate hassle, more life.

I could be wrong. The technology of the near future may instead be designed to refine our sensibilities still further in the directions of change of the past several decades: toward personal security, toward isolating ourselves from our machines, and toward being able to do everything everywhere. Cities connected by cars on rails that arrive empty at your home and leave you at work before they pick up another passenger, heavy cars to make the ride smooth. (The Personalized Rapid Transit systems on the drawing boards are usually presumed to operate under such constraints.) Junking consumer products at the first sign of breakdown. Recreation of all kinds available at all places and all times: outdoor iceskating rinks in the Caribbean, heated swimming pools (heated *lakes*?) for winter swimming in the Adirondacks.

It seems more likely to me that we are in the early stages of an intellectual and cultural sea change. Images of saturation of wants go only part of the way toward explaining why the near future should not be predictable by a straightforward extrapolation of the recent past. For part of what is involved is the development of new wants and the rediscovery of ancient ones, a development that Laurence Tribe and Robert Dorfman sketch in their essays as a kind of "groping upward." An important class of new wants that is already palpable expresses a desire for interaction with "the only earth we have." These wants will call into being still uninvented technologies, public policies, and styles of discourse appropriate for such a resource-respectful new world.

III. THE SPECIAL PROBLEMS OF ECOLOGY

Biological information can be relatively easily tracked by the observer of decision making, in part because it is less emotionally charged than political or economic information, so people will talk about it, and in part because it is still novel, so people tend to have clear impressions of what they know and where they've learned it. Accordingly, the study of how biological information is processed in the course of making decisions about the use of natural resources ought to give insight into how other kinds of information are processed as well. In three matters—eutrophication, shad, and oysters—ecology has played a prominent and visible role in decision making.

A. Eutrophication of Tocks Island Lake

Tocks Island Lake, so named at the time of its conception, may turn out to have poor prospects for a healthy existence. Other reservoirs in the region regularly eutrophy in the late summer—that is, they develop pockets of foul smelling weeds along their shores. Rivers are intrinsically easier to take care of; they train themselves. The key quantitative parameter is the flushing time—the mean residence time for the water (and hence for any nutrients entrained in the water) from time of entry to time of exit. It is measured in *months* for a lake and in *days* for a river.

If the shoreline is coated with scum, the lake's value for recreation will be greatly impaired. This direct connection between biology and people has made the issue of eutrophication the pivot for large political motions. Eutrophication provides the opponents of a dam with the first argument that matches flood control in its capacity to embarrass: signs saying *Highway Flooded* with a dam unbuilt and signs saying *Beach Closed* with a dam built are both distressing images, and the politician instinctively shuns association with either of them. He cares about embarrassment a lot more than about the possible need to recompute the number of recreation visitor-days, but the two are linked.

The eutrophication issue has implicated the upstream bystander, New York State, in a new way. The nutrients carried in the runoff from poultry farms and municipalities far above the dam site would be trapped in the lake, where they could contribute substantially to the stimulation of unwanted biological growth. The votes of New York's politicians, including its governor (a member of the Delaware River Basin Commission) are now cast more cautiously, for the expenses of controlling runoff are considerable. Ecology has shrunk the distances along the river, involving those over 100 miles upstream from the dam in the fate of those beside the dam and (as will be seen below) with the fate of those over 100 miles downstream from the dam as well.

But the reservoir may not eutrophy. Systematic measurements of the mineral content of the inflows into the Delaware and its tributaries are only just beginning, and it is not possible to make even an educated guess. In all the data available in 1973, there were just twenty measurements of phosphorus (the most critical nutrient) in the entire reach of the river where the lake would form. The extraordinary casualness about data acquisition is a significant phenomenon in its own right. It is especially mystifying in a setting where the same people who are casual about data are found commissioning a procession of technical reports on the subject of eutrophication. The earliest of these, the "McCormick Report," carries a lament at the sorry condition of the data and pleads that something be done before the next report is commissioned.[1] Thomas Cahill, two years after participating in the writing of the McCormick Report, found the "resistance by the responsible agencies" to undertaking programs of data acquisition in the field "stubborn, almost irrational."[2] In the past three years, the Corps of Engineers has spent its research funds on an elaborate computer model, *Lakeco*,[3] and on a study of how eutrophication, if it were to occur, could be cleaned up.[4]

With the introduction of *Lakeco*, the discourse about Tocks Island Lake may demonstrate new pathologies. Computer output has a way of paralyzing those who look at it, at least temporarily. The output of *Lakeco* takes the form of graphs of biological load in the lake versus month of the year, for various assumptions about inputs of nutrients; it appears to give the answers the political process needs. To the credit of the Corps and its contractor, *Lakeco* has been published with complete annotation, and the computer deck has been made available to interested bystanders. Nonetheless, there is no institutional mechanism to provide a critique of the report, which is full of patently unjustified assumptions. The model is an exercise, a milestone in a developing art. It has not yet carried more weight in the political process than it deserves, but it stands unchallenged, waiting to be believed.[l]

B. Shad

The shad, like many species of salmon and trout, is anadramous—that is, it spawns in fresh water and lives most of its life at sea. One of its spawning areas is above the site of the dam. The shad problem was recognized from the outset of the project, and has been dealt with in the traditional fashion: a fish ladder was included in the dam project. It was acknowledged that most of the shad trying to use the spawning area would not get there or that their offspring would not get back to the ocean. The ladder, however, was clearly better than nothing and was not very costly. The shad was acknowledged to be abundant elsewhere, to be subject to numerous other hazards (such as those encountered in navigating the stretch of water with low

[l]Three of my colleagues on this research project, Robert Cleary, Daniel Goodman, and Douglas Zaeh, have been investigating *Lakeco* and its application to Tocks Island Lake. It is possible that their critique of the model's hydrology and biology (in the companion volume) will check the usual tendency of models of this kind to carry unjustified weight. But such matters obviously should not be left to the chance attentions of a nearby research group.

dissolved-oxygen content in the polluted Delaware estuary), and to be replaceable (at least from the fisherman's standpoint) if a program of stocking the lake behind the dam were undertaken.

To many builders of dams, fish ladders represent "going the extra step" to accommodate their environmentalist critics, and to placate the environmentalist in themselves. At some dams in the west, a visitors' gallery is installed from which the fish can be watched as they climb. Evidently, our fascination with their strength and determination overrides our dismay that we are putting them through such paces. Or perhaps debates ensue in the galleries—I should like to know—and consciousness is raised. To some ecologists, however, fish ladders represent kidding yourself. You see fish climb the ladder successfully, but you do not see them lost in the lake, or (even more likely) their offspring unable to find their way back downstream. Both migrations are keyed to fast-moving water.

How can such incompatible perspectives continue to coexist? Fish ladders appear to provide the means for resolving the conflict, for they usually double as devices for counting fish, keeping score each season. With so many fish-ladder-years of experience behind us, we must have some respectable quantitative information about how various ladders affect the numbers of fish arriving each year, sorted by species, by distance upriver, by month of the year. Or are ecologists unwilling to consider such data respectable? Ecologists are wary of quantitative indices of performance, for they are oriented to a world full of nonlinearities and thresholds. If the population climbing a fish ladder drops annually an average of 5 percent over several seasons, the ecologist will not agree that one could infer the number of years it would take for the population to drop to one-fourth, because a later drop could be abrupt. "No one knows the minimal oceanic population necessary for the survival of the species."[m] The ecologist thus spreads a pall of ominous uncertainty over the entire enterprise of environmental planning. Still, it is curious how little attempt is made to make the argument quantitative.[5]

C. Oysters

The fate of the Delaware Bay oyster is bound up with the dam much as is the shad's. A routine approach analogous to the fish ladder does not exist in this instance, however, and the discourse on oysters has accordingly been more inventive and more bizarre. The oyster beds, 150 miles downstream from the dam, are in a

[m]This was Lincoln Brower's response to an early draft of this essay.

deteriorated condition relative to 50 years ago, and they are menaced by a predator known as the oyster drill. It is widely believed that the seasonal high flows of fresh water down the Delaware and into the Bay in April, May, and June are protecting the beds from further assault by the drill, because the oyster is able to tolerate less saline water than the oyster drill and hence gets rid of the drill during that season.

Except for one year in 60, the lake behind the dam is supposed to be full before the spring months of high flow begin. Thus the natural flows (except flood flows, defined as flows in excess of 70,000 cfs) are expected to pass through the dam undiminished each spring. Between the dam and the oysters, however, water is expected to be withdrawn for out-of-basin shipment. The continuity of out-of-basin diversion provided by the reservoir constitutes a major justification for the dam. This diversion can only continue during the spring months at the expense of the water flow to the oysters. Thus, advocates of oysters and advocates of out-of-basin regional growth are potential adversaries.[n]

No one who understands this conflict of interest appears willing to break the news to those who don't. Once, searching vainly for an analysis of this conflict, I was told by a minor Corps functionary, "Who can put a price on the life of a fish?" Yet, within the Corps, it is clear that the overconstrained character of the oyster problem is recognized. With quintessential American optimism, however, the Corps is trying to find a way to *improve* the oyster beds, a way to get them back to their state of 50 years ago, or even better. The Corps is hoping to find a way to do this through a procedure of timed releases of fresh water, all through the year.

The presupposition of such a study is that man can improve on nature. Among conservation groups, however, the oyster issue has had a completely different symbolism. The oyster's dependence on an annual pulse of fresh water is regarded as an *indicator* of the dependence of an entire estuarine ecosystem on that same annual pulse. The life cycles of myriad organisms are tied to these seasonal

[n]By the hydrologist's measure, the Tocks Island Dam, relative to its basin, is not big. To further even out the uneven flow would have required larger storage capacity, and the dam is *not* larger primarily to avoid either drowning or diking Port Jervis, 37 miles upstream. The construction of additional storage capacity on- or offstream should be expected if the goal continues to be to increase the "yield" (the minimum continuously deliverable flow) from the river valley; the yield is maximized only when the flow is completely evened out. Each future storage area will present the same trade-off problem: uneven flow for the oysters, steady withdrawal for man.

fluctuations, and even if another way could be found to protect the oysters from the drill (by chemical or biological control, for example), there would still be other kinds of damage in the estuary if the fresh water pulse were removed. The presupposition here is that man can only diminish the quality of the natural environment by his intervention—that "nature knows best." Although logically inadequate as a guide to problems such as pollution control, in which one intervention of man is designed to reduce the consequences of another, the presupposition is nonetheless a touchstone for a large number of "preservationist" attitudes, which contravene the prevailing interventionist attitudes of most foresters, fisheries managers, and other environmental scientists.

So, whither has policy evolved in this new Age of Ecology? The Corps of Engineers now explores the ecological consequences of its projects. The Fish and Wildlife Service of the U.S. Government intervenes on man's behalf whenever either commercial fishing (oysters) or sports fishing (shad) is threatened. The Corps, in response, reformulates the task of protecting a fishing resource into the task of enhancing it. The Corps consults with leading biologists. It is a new Corps, a more and differently responsive bureaucracy, and, far more than previously, there is a biological dimension to decision making.

The economists tear their hair. What happened to costs and benefits and to the market—to transfer payments to the oystermen, for example, if their beds are destroyed, or payments *by* the oystermen if the beds are improved? There is nothing intangible or fragile about oystermen, so why should traditional methods of economic analysis suddenly be abandoned?[o]

The conservationists tear *their* hair. Their starting point is piety and self-doubt in the face of nature, and somehow it has gotten lost. To gain entry into the discourse, they talk about a cash crop; to avoid sounding softheaded, they fail to emphasize that, in their view, the "cash crop" is merely an indicator of the condition of a far more valuable ecosystem. The conservationists have separate languages for talking to one another, to politicians, and to their avowed oppo-

[o]To be sure, there are intangible values at stake in the survival of the villages whose local economies are entirely dependent on the oysters, villages with pride, tradition, and people having untransferable skills. Such costs are like the costs of burying under water some of the historic farming villages upstream from Tocks, costs that the present-day cost-benefit analysis appears not to be equipped to incorporate.

nents. Except when they talk to one another (and perhaps even then) they refrain all too often from articulating what really matters to them.

"Professionals," according to one definition, "don't back one another into corners." "I'd rather argue a point of procedure than a point of substance," another professional told me. Self-censorship is a tactic that keeps coalitions together and keeps opponents on speaking terms. But self-censorship, nonetheless, has considerable costs. Some of the costs are political. When a dialogue proceeds under false pretenses, its participants rapidly grow bitter; if after much effort you have scored a point, and your opponent acts as if the score is unchanged (because it really is), you want to quit. The Philadelphia office of the Corps now feels this way about the Environmental Defense Fund, and expresses a strong desire to keep its distance.

At another level, perhaps even more vital, the cost of the conservationist's failure to articulate what most troubles him is the loss of crucial information in the decision process. Many people outside the conservation groups assume that ecological insights are the property of conservationists and are up to them to introduce into the discourse. But what if they don't want to? Once, among conservationists planning strategy, I asked whether floods were beneficial to the life on the river banks. I was told to stop wasting everyone's time; the answer was obviously yes, there was a good movie that showed why,[6] and "this is not what one whispers in the governor's ear." Well, why *not* whisper this into the governor's ear? If the river banks will deteriorate, the governor should know it. If ecologists don't really know, but think they know how to find out, then the support of such research should get high priority.

The question, "Do ecologists really know anything useful?" is on many people's minds. The answer appears to be that, at the very least, they can distinguish among what they know with assurance, what they have hunches about, and what "pop" concepts they see no evidence for whatever. As long as their knowledge is not systematically incorporated into environmental discourse, the United States can continue unfolding its environmental programs and then folding them up again, acting as if only distributive issues and not "real" consequences (duck hunters' votes and not ducks) are at stake. Do estuarine ecosystems become less productive or just different when dams are built? I have the impression that most ecologists believe they know the answer to that one—that indeed a lot *can* be said about how an estuary is damaged when it is simplified; if so, the information may be too important to be left to the conservation groups to introduce.

The ecologists may not have welcome news (indeed, one of the first anthologies on ecology was called *The Subversive Science*), but they must be encouraged to speak, and they must be *questioned.* They have had something essential to say about DDT, and about predator control programs; in the process, we have all learned about food chains. By clarifying the importance of rhythms in nature, ecologists may cause us to rethink some of the practices that have grown up around the assumption that it is invariably to man's advantage to smooth out nature's peaks and valleys. To take a single example, the whole basis of the bartering between interests representing different river basins may be built on faulty ecological principles. The crux of this bartering is the concept that if you take water out of a basin when water is abundant, you must promise to return water to the basin (by releases from a reservoir) when water is scarce. (This is the sort of arrangement New York City has with New Jersey and Pennsylvania, as described in Section II B, above.) The result, if the agreement is respected, is that river flow is evened out. But a river that flows evenly is not a natural river, however convenient it may be to man; plants and animals, in countless well-understood ways, are keyed to the seasonal flow engendered by melting snow. By various yardsticks such as species diversity or production of desired species, the evening of flow could be judged to have deteriorated the river. The repayment with low-flow augmentation could be judged to have negative value.[p]

Ecologists may have something even more disturbing to say about the benefit nature derives from her most *extreme* variations, such as forest fires and floods, as opposed to her regular seasonal variations. If redwoods have depended on periodic forest fires to clear away the understory, and if mangroves have depended on floods to propagate to new locations, what is man to make of such information? The benefits of nature's excesses come as a surprise to those of us who grew up in a culture that emphasized that what was destructive in nature it was man's responsibility to tame (like his temper). The benefits of seasonal flow are less difficult to appreciate; after all, we have our own daily and monthly clocks built in.

[p] A system of values that elevates man's convenience is flawed in other ways, as Charles Frankel reminds us in his essay in this volume: the very enterprise of bringing some of nature's rhythms under deliberate control takes something important from our experience of the world.

IV. IF I LEARN TO LISTEN, YOU MAY LEARN TO CONVERSE

A. People Are Imagining Futures Very Different From One Another

- A man high in the Corps of Engineers says, "Either there is a problem with this valley or there isn't one." He means that the valley has many rivers and streams that with little notice can cause destruction and loss of life, more severe with each passing year because of the way land development increases the speed of storm runoff. He also means that the available water supply, if no further dams are built, is going to inhibit regional economic development; perhaps the permanent underground aquifers are already being depleted.
- A Park Service official shows his visitors a sloping cornfield upstream from the dam site and describes how it will become a site of "quality recreation" when the lake fills in: the site will become a beach (it has just the right slope) and, between it and the parking lots, there will be self-guided nature walks, ecology exhibits, shops where local craftsmen will display their works, and the oldest houses and barns of the region, transplanted to these places of highest frequency visitation so that the maximum number of people can become involved. "If the dam isn't built and there isn't a lake here to attract visitors," he argues, "the National Park Service has no business being here."
- A planner in a state agency says, "If we hadn't gotten the federal government into the area, the whole riverfront would have been overwhelmed by land developers, carving up the area for second homes. Until that far-off time when local zoning is effective, we have no choice but to get the federal government involved in restricting the area's development."
- A local mayor tells an inquiring commissioner that he doesn't see how his town can afford another ambulance to handle the accidents that the increased traffic on his roads will generate, and that a majority of his constituents oppose the dam because, with all those city people coming through, each will have to get a lock for his front door.[q]
- A Washington-based planner says, "The number of people who live in New Jersey and commute to work in New York City is too large already. If we don't build the dam, the regional economic and population growth will be slower, and the country will be the better for it. Some of the people who would otherwise have moved to New Jersey from the states in the middle of the country will stay there and some of the people who are leaving New York City will go on past New Jersey

[q]In a referendum in November 1972, in Warren County, New Jersey, which includes the dam site but little of the land that would be flooded. 9,218 people approved the construction of the dam and 14,864 opposed it.

to live in those same states; otherwise, those states will soon be losing population."

- An ecologist worries that managing the water quality in the lake behind the dam will be a continual headache, and that asking for the lake to be suitable for recreation as well as water supply is compounding the problem, both because the visitors' activities add to the waste load entering the lake and because the visitors' activities require higher minimum water quality standards to be met.[r] He also comments, "The river is an organic unit, and now flows well over three hundred miles with hardly an obstruction. Plugging it up at mile 217 will alter the entire structure of interdependence of upstream and downstream life."
- A scoutmaster says, "The valley is perfect just as it is for getting boys and girls from suburbia into the woods for a weekend, where they won't see many people and can learn to take care of themselves. You can't find a better place for beginners to learn canoeing near here either."
- A conservationist says, "We've got to learn to accommodate to nature sometime; why not start here, while there is still some room to maneuver? If the dam is built, nuclear power plants will follow, plants now foreclosed because of the undependable flow in the dry season; that's just pushing your luck. If the dam isn't built, a lot of promising ideas about how we should accommodate to natural limits, like water metering and recycling, flood plain zoning, effluent fees for pollution discharge, energy conservation technologies, and staggered work weeks, will get a more serious hearing. The better ideas will be sorted out from the worse ones while there is still little risk in experimentation." (In the Corps' calculation of recreation benefits, it is assumed that 32 percent of the annual visits to the National Recreation Area will occur on just fourteen days—summer Sundays.)[7]
- An esthete says, "You can see over twenty miles across the valley on a clear day, and there's hardly a work of man in sight. There's no other view of rolling hills anything like the one looking out over Wallpack Bend. And downstream, where each Christmas Washington's crossing is reenacted, you still see the river as it flowed in 1776 (though the bridge right at the spot does detract somewhat); even if only for its place in history, wouldn't the Delaware be a good river to leave unmanaged?"

Out of such conflict, what resolution? It is presumptuous to give blithe answers, but to offer no answers at all is irresponsible. I join several of the other authors in this volume in believing that, as a modest first step, it is worth trying to refine the ways in which the participants in such discourse are assisted by the available technical

[r]The Cannonsville Reservoir on the west branch of the Delaware is currently used for water supply and also develops "nuisance blooms of blue-green algae" in the summer. Recreation on the reservoir is not permitted.

information. The basic methods of science, for all but a very few participants, are not themselves controversial. If some consensus can be achieved over matters of geophysics (hydrology in the Tocks case, meteorology in many other land use disputes), matters of biology, and, perhaps, matters of economics, then it is possible that a foundation for productively confronting ever more sensitive layers of the debate could be established. Even by itself, the exercise of ordering the existing disagreements according to a hierarchy of arguability may be salutory.

B. Models and Data Must Be Located in More Helpful Places

A moderate amount of science and an enormous amount of data usually pertain to a given policy decision related to natural resources. In the case of the Tocks Island Dam, historical flows of the Delaware at several gauging stations are available stretching back many decades. The historical record can be restated in stochastic form (giving the probability of recurrence of various degrees of flooding and drought, among other things) and can be "rerun" on a computer with any desired assumption about reservoir releases, out-of-Basin shipments, consumptive losses, and so forth. The water professionals agree with one another to a very large extent concerning how their analytical tools should be used, and the approach they take is not particularly dependent on who the client is: anyone's preferred strategy for management of the river's water flows would be analyzed in essentially the same way. Not only are the data base and the analytical procedures common property resources; so too are the problems of uncertain and missing data, of extrapolation, and of oversimplification in modelling.

One might expect analysts occasionally to be encouraged to assume a neutral stance and to generate an array of results flowing from deliberately varied starting assumptions representative of several conflicting points of view. But this does not in fact happen. One reason, I believe, is that expertise is so widely presumed to be the captive of the adversaries. The model of the court of law is devastating: we have come to expect an insanity trial to produce a psychiatrist for the defense and a psychiatrist for the prosecution. Some environmental expert is presumed to be available who will come out with any answer for which a combatant is willing to pay. The analyst's results are presumed to be little more than the packaging of opinion and sentiment.

Although such attitudes are more often accurate than one might wish, they represent a significant exaggeration. And the costs of such attitudes are high indeed. Not only does a common ground among adversaries fail to be established, but, perhaps just as serious, a constituency for nurturing the data base and the analytic techniques fails to develop. No one in a position to do anything about it cares whether measurements are made or not. Yet almost inevitably, because new issues keep arising, critical data are missing. After years of consultants' reports pleading for the taking of data on the flow of nutrients into the river (as discussed in section III), such a program is still not underway, in spite of the fact (or perhaps because of the fact) that the politically most troublesome technical issue in the current Tocks debate—the likelihood of eutrophication of the reservoir behind the dam—largely depends for its resolution on the availability of such data.

The most unfortunate cost of excessively disparaging the technical tools is the discouragement of sustained efforts to generate alternatives. When a computer stores large blocks of historical flow data and a few elementary routing routines, it cries out to be played with. Questions of the "What If" variety, the seeds of all inventive proposals, are all but certain to germinate if such an invitation is accepted. Yet, today, the ground is not fertile. No one wants to hear. No one has such play as his work.

It is worth looking hard for ways to activate the better use of the relevant "hard science" in policy making. One obvious possibility would be to dissociate the experts from the historic adversaries, in at least a few institutions. Suppose that, in each major river basin, a facility could be established and nurtured which at the least would house the hydrological capability I have just described as well as, presumably, comparable demographic, social, economic, and ecological data banks and software. It is conceivable that, over time and abetted by the staff of such a facility (who would of course seek to justify their existence), the facility would find ways to be useful to a wide range of clients. At such a Center for the Delaware River Basin, the Greater New Jersey Chamber of Commerce, Trout Unlimited, the City of New York, the Environmental Defense Fund, all could come to refine their preferences.

The staff of such a facility would press for further data gathering and model development, and might logically take responsibility for this enterprise. But monitoring the modelers must also be accomplished somehow. There is a market in elaborate computer models today, and it resembles the market in dangerous toys; there is something a little unsavory about sellers and buyers alike.

The seller may have initially developed his model for a research problem to which it was relatively well suited, and the buyer may have begun with a policy problem an appropriate model could clarify. But bargains are struck when there is no match possible. Perhaps the necessary input data do not exist; perhaps the model has structural limitations (inadequate grid size, dimensionality, time dependence); perhaps the positivist character of the output is certain to blind the recipient to its defects. At an earlier time, before computers, it was harder to lose track of a model's uncertainties and imperfections. The water professionals resorted to physical analog models, scaled and distorted, equipped with faucets, wave generators, bottom rougheners, and other hardware. But today's numerical models are often not significantly better in fact at prediction, especially when they are run under a constraint of "modest cost." It is worth thinking about how to structure a center for modeling so that it has incentives to be candid about its models' shortcomings.

The structuring of improved environmental discourse poses other problems of institutional design that can only be touched on here: sources of financial support for the facility, the merits of embedding the facility within a university or national laboratory, its relation to existing facilities, and the confidentiality of both the data and the assistance rendered the clients. The facility should almost surely retain a "service" character, like the Library of Congress, rather than becoming itself the generator of policy. The best (most thorough, most inventive) analysis will usually be demanded only by those who have a stake in the outcome (whether bureaucratic, financial, or emotional), and it would surely be unwise (even if possible) to create a facility that becomes so smart that all the initiative passes to it.

Even those with no initial stake in the outcome can often be helpful: they ask usefully awkward questions. One would like to build in a role for them. I have twice been part of a group of such outsiders, and in each case we left behind us a considerable alteration in perceptions.

In a 1969 summer study run by the National Academy of Sciences, a group of us worked quietly in California trying to understand the raging debate over whether a jetport should be built near the northern boundary of Everglades National Park, in Florida. The conservationists and the land developers flew across the country to talk to us. We discovered that both groups had a working hypothesis that if one was for something, the other ought to be against it. But, in fact, there was an outcome *both* had reason to fear, on different grounds, and so could unite to prevent: the drainage of the interior. The water flowing slowly southward through the inland region containing the jetport site not only prolonged the wet season in the Everglades, establishing critical rhythms for the entire ecosystem, but also played an essential role in protecting coastal fresh water supplies, so that coastal land development and inland drainage were incompatible over the long term. The developers, in particular, had not appreciated the scale of planning that limits to fresh water resources demanded. By emphasizing the opportunity costs of a future of unplanned regional development, our report (along with several others) led state and federal officials to reappraise the value of "undeveloped" land. A consequence of that reappraisal has been the creation by the federal government of the Big Cypress Swamp Water Conservation Area, a development which, at the time of our study two years before, had seemed unwise both to the conservationists and to the developers—extravagant to the former, an infringement on property rights to the latter. Another consequence has been the relocation of the jetport 30 miles to the northeast.[8]

A similar reappraisal of the value of undeveloped land occurred as a consequence of the 1970 National Academy of Sciences summer study of plans to extend Kennedy International Airport into Jamaica Bay. The attitude of public officials to the Bay as a recreational resource, other than for bird watching and nature study, was well expressed by the head of the New York City Department of Parks and Cultural Affairs when he said, "If you put your foot in that water, it will come out bones." Accepting the assumption that the objectives of an extensive program of water pollution control already underway would be fulfilled, our group emphasized a possible future in which Jamaica Bay would be intensively used by the people of Brooklyn and Queens for water sports. By suggesting modifications of a plan for the extension of regional subways that would permit access to the Jamaica Bay shore, and by suggesting locations and estimating costs of shoreline beaches, we were able to help those involved in the future of the area to imagine new alternatives. A consequence of such altered perceptions has been the redesign of the Gateway National Recreation Area: it now includes the shore of Jamaica Bay, where previously the boundary had been drawn at the water's edge.

The moral of these two stories, for me, is that no group of analysts, however constituted, should ever imagine that their work—whether it focuses on the "science" of a dispute or its politics—can proceed apart from the debate, for it always becomes part of the debate. As Laurence Tribe observes in his essay, "any analysis must become part of the process it has helped to shape." This is the classic conundrum of the observer and the observed embodied in Heisenberg's Uncertainty Principle, and it assures that the work of the analyst of land use disputes will have consequences —in the unfolding of that dispute and other disputes. I would rather commend to analysts the assumption that *everyone* is listening and will go on listening. Like Lord Keynes, I would expect that "madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. . . . Soon or late, it is ideas, not vested interests, which are dangerous for good or evil."[9]

C. What We Should Hear Before We Say the Discourse Is Good Enough

Once the quantitative analysis is so located that all interested parties are served, the discourse might just begin to sound quite different. I cannot imagine more than a fraction of the themes we might hear; but I would regard the appearance of straight talk about any of the following to be a signal that a transition had occurred.

1. **Bigshots.** The sheer size of Tocks is a source of excitement. For those who might build the dam, it is a challenge to their organizational and technical skills—a challenge that enlarges their perception of themselves. Correspondingly, the high stakes (the expenditure of about a billion dollars is in the cards for dam construction, new sewer facilities, and additional transportation access) spur on the activists in the conservation groups, who believe that only victories on issues like Tocks will ever get a fair hearing for their broader philosophical analysis of modern society.

Stopping a project this big will thrill a conservationist in a way not very different from the way building it will thrill a Corps engineer. It is debatable, under the circumstances, whether big projects get wiser consideration than little ones. Big projects may get a first-string team, so that there is less carelessness and foolishness, but they also engender momentum for its own sake—the drive for victory rather than compromise.

To like being a bigshot is pretty human. Yet it dampens the enthusiasm for taking seriously the packages of single-purpose projects, the half-dam and quarter-dam strategies, which (as discussed in section II) are often meritorious alternatives to the one big structure. Building a set of wing dams that jut partway across the river and create swimming areas in the slow-moving water behind them doesn't count for much today. A discourse grown sensitive to bigness will display creativity in the scoring and rewarding of intermediate accomplishments.

2. Little Guys. The local residents live with the uncertainty that the stalled discourse has brought. Most would prefer a decision either to build or not to build, relative to a decision to postpone deciding. This fact confounds the kind of analysis usually regarded as optimal: one that keeps the options open.

The Corps has been acquiring the land where the lake and the National Recreation Area are to go. Some of the people who have had to sell to the Corps are bitter about the procedures by which these sales have been accomplished, and they are persuasive when they argue that there are not enough built-in safeguards to protect them. Given the fact that much of the fuel for the opposition to the dam comes from these bitter residents, the current procedures for land acquisition are clearly suboptimal.

It used to be presumed that if people want to live on flood plains, the government should not stop or even dissuade them; a proper role for government was simply to assure that those living in flood plains were aware of the risks. Flood-plain zoning generally goes much further, setting the government in systematic opposition to the determined risk taker. It may be that the characteristics of this silent confrontation could be usefully illuminated.

The urban poor in the inner cities of Newark, New York City, and Philadelphia who do not have cars will not be able to travel the 50 to 75 miles to the National Recreation Area, whether river-based *or* lake-based, if there is no public transportation. What subsidies, if any, would be required to provide such public transportation at prices these groups could afford? If subsidies of this sort prove to be necessary, those who make their approval of any particular form of the project conditional on its serving the needs of the urban poor ought to insist that the project incorporate such subsidies. There is a risk of self-deception if this problem remains unexamined.

The recreation area, politicians sense, will be used by different groups if it is built around a river or around a lake. What characteristics differentiate these two groups? A careful answer to this question would clarify the currently muddled perception of winners and losers.

3. Wilderness. Men can now move mountains, melt icecaps, turn rivers around. Their power to assault leads to competing images of nature as victim and nature as ward. In either case, nature is politicized.

Doing nothing has now become a judgment: the act of not implementing a technology to modify a natural phenomenon is politically and morally different from the act of leaving nature alone at a time of innocence. Apparently, Fidel Castro, following a devastating hurricane over Cuba, went on the radio to accuse the United States *not* of seeding the hurricane in a way that went awry, but of *failing* to seed the hurricane, knowing that it would hit his country.[s]

Suppose a decision is made not to build the dam, and the following year an immense crack develops in the Kittatiny Ridge, rocks begin to tumble into the valley, the river becomes plugged, and a lake builds up behind the plug. Does the Corps restore the navigable waterway?[t] That the river should have standing in such a decision seems appropriate.[10] But if I were the guardian for the Delaware, I would be perplexed. I would not want my ward to drown Port Jervis and other human settlements on her banks. I would expect to see some abridgement of her prerogatives. Why should I assume that my river is a savage? Might not a river *like* the idea of being helpful to man? It is not obvious to me that the end result of an enlargement of rights must be an enlargement of selfishness.[u]

The problem of rocks falling into the river was posed in a discussion between dam builders and dam stoppers at a university, a setting that permits some of the usual rules of discourse to be

[s] I owe the story, as well as the basic thought in this paragraph, to Edith Brown Weiss.

[t] The Corps of Engineers, in its environmental impact statement, considered the possibility of taking the *dam* apart at a later time. The two relevant paragraphs are extraordinary enough to merit full quotation:

> With the exception of a large permanent rock face at the left abutment, occupation of the area by the project facilities does not in general constitute an irreversible or irretrievable commitment of resources.
>
> The major resource commitments are less enduring and of restorable character. In areas of local protection works the natural stream banks will be lost and replaced with flood walls and levees. The corridor of relocated U.S. 209 due to grade adjustments requiring cut and fill represents an artificial land modification. These features could be removed and the area completely restored to its pre-project uses, should future generations find that such removal and restoration could serve some greater public economic or social good. The construction of the basic dam embankment although very massive does not preclude its alteration or removal. While truly a major undertaking, this change could be made for a compelling (and as yet unknown) future need.

[u] As Laurence Tribe argues in his essay, "recognizing rights in a previously rightless entity is entirely consistent with acknowledging circumstances in which such rights might be overridden. . . ." My point goes a bit further: it is that recognizing rights does not preclude imposing responsibilities.

suspended. I look forward to the day when it is usual to have more open, more self-critical, even more playful discourse. I do not argue on grounds of efficiency alone; I rely on more than the enhanced potential for resolution of conflict. Such arguments from efficiency are not self-evident; if one knows one's neighbors better, one may want *less* to compromise with them. Improvements in discourse can be better justified in terms of higher ends than the instrumental one of "solving" the problem at hand. The new discourse would manifest a fuller expression of the diversity of preferences and emotional commitments of the participants. It would enhance the sensitivities of both participants and bystanders to the complex, tragicomic process of self-definition a culture goes through when it seeks to resolve any of its hard problems. It seems worth pursuing for its own sake.

NOTES

1. Jack McCormick and Associates, *An Appraisal of the Potential for Cultural Eutrophication of Tocks Island Lake* (U.S. Army Corps of Engineers, September 1971).

2. Thomas H. Cahill, "The Potential for Water Quality Problems in the Proposed Tocks Island Dam Reservoir," in G. E. Schindler and F. W. Sinden, eds., *The Tocks Island Dam, A Preliminary Review* (Save the Delaware Coalition, 1973).

3. Water Resources Engineers, *Lakeco: A Model of a Reservoir* (December 1972), and *Ecologic Simulation—Tocks Island Lake* (February 1973).

4. Wapora, Inc., *Tocks Island Lake: Techniques for Water Quality Management* (1974).

5. For a qualitative description of the state of the art, and a glimpse at the magnitude of current effort, see G. J. Eicher, "Stream Biology and Electric Power," *Water Power* (June 1973): 211–218.

6. *The Flooding River*, by Lincoln Brower, made in 1972 and available from John Wiley & Sons, New York.

7. See the *Report on the Comprehensive Survey of the Water Resources of the Delaware River Basin*, Appendix W, "Recreation Needs and Appraisals," House Document 522, 87th Congress, 2nd Session (1962), p. W-18.

8. See "The Everglades: Wilderness Versus Rampant Land Development in South Florida," in John Harte and Robert H. Socolow, *Patient Earth* (New York: Holt, Rinehart and Winston, 1971).

9. J. M. Keynes, *The General Theory of Employment, Interest, and Money* (New York: Harcourt Brace and World, 1964 ed.), p. 383; originally published in 1936.

10. The seminal essay on this subject is Christopher D. Stone, "Should Trees Have Standing?—Toward Legal Rights for Natural Objects," *Southern California Law Review* 45 (2):450–501. He was anticipated in some respects by Dr. Seuss (Theodor Seuss Geisel), *The Lorax* (New York: Random House, 1971).