Technology Assessment and Social Control

A conceptual framework proposed.

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The emerging concepts of corporate responsibility and technology assessment are, to a considerable extent, responses to problems arising from technological developments and their applications by industry and government. These problems appear in the relatively discrete sectors of consumer protection and occupational safety and in the diffuse sectors of community quality of life and the national and international environments.

Consumer Protection

As products have become more sophisticated and defects in them less easily detected by the consumer, the common-law principle of caveat emptor, "let the buyer beware" has been largely abandoned by the courts, and the principle of strict corporate liability has been frequently adopted (*1*). Federal and state legislation and regulatory agencies for consumer protection have multiplied with this shifting of responsibility. Nevertheless, common law, legislation, and regulation pertaining to product safety have been largely ineffective (*1*, p. 2):

> . . . federal authority to curb hazards in consumer products is virtually non-existent . . . legislation consists of a series of isolated acts treating specific hazards in narrow product categories. . . . Despite its humanitarian adaptations to meet the challenge of product-caused injuries, the common law puts no reliable restraint upon product hazards.

As a result, Ralph Nader and other crusaders have mobilized citizens against specific technological developments embodied in hazardous products and processes—such as the Corvair and various food additives.

The 92nd Congress enacted the Consumer Product Safety Act, thereby creating an independent commission with the authority to develop mandatory safety standards for many product categories and to carry out related functions to protect consumers (*2*). However, regulation of automobiles, drugs, boats, foods, and other product categories is excluded and left to existing programs. The commission is expected to maintain the regulatory agency tradition of reliance on industrial testing and reports; and "Except for the availability of [commission] information and the opportunity for litigants to argue the fact of compliance or noncompliance with mandatory Government standards, the law is expected to have little effect on products liability litigation" (*3*). It is too early to determine whether or not the law will bring about an effective regulatory program.

Occupational Health and Safety

The incidence of harm to workers, the difficulties of employee recovery under the common law, and the inability of the judicial system to internalize such "costs" sufficiently to bring about a preventive approach by corporate management are among the factors that led to workmen's compensation laws and insurance programs (*4*), and agency standards for occupational hazards. The National Labor Relations Act (*5*), and most recently the Occupational Safety and Health Act (*6*) have provided frameworks for decision-making on automation and hazardous technological developments. Nevertheless, high injury rates persist in several industrial sectors (*7*) as old and new technology continues to create lethal environments for employees —for example, "The National Academy of Sciences reports a study showing that the life-span of radiologists is five years shorter than the national average . . ." (*8*, p. 13).

The introduction of new automation technology has traditionally brought about strong union opposition because of impacts on job security (*9*). Now, impacts on employee health provide new bases for opposition. As a result, some new, highly automated plants have been shut down—Rio Tinto's lead processing plant in the United Kingdom and General Motors' Vega plant in Lordstown, Ohio, have recently suspended operations until the economic and the physical and mental health effects of new automation technology on employees could be determined and diminished (*10*).

Community Quality of Life

The impacts of industrial and government technology on health, land use, esthetics, and other aspects of community quality of life (*11*) have finally aroused organized citizen opposition. Government transportation and energy programs are now persistently opposed by local communities. Corporations that have traditionally provided the economic base for communities are now increasingly confronted by litigants seeking compensatory damages, restraining orders, and injunctions; by newly aggressive local officials responding to citizen complaints and invoking long-dormant police powers against noise, smoke, and other nuisances; and by state and federal officials enforcing air and water quality programs. Despite judicial reluctance to enjoin ongoing industrial activity that concurrently provides local economic benefits and environmental degradation (*12*), the expanding enforcement of public nuisance and pollution control laws has recently brought about a number of plant closures (*13*).

Nevertheless, the economic objectives of states and local communities and the fear of job losses and other dislocations that would arise from project or plant shutdowns will continue to determine the pace at which

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community quality of life is rehabilitated and environmental degradation controlled (*14*). The complex task of resource management must be undertaken by state and local governments. How else to reconcile the objectives of economic and social opportunity—housing, economic development, transportation, and so on—with enhanced community quality of life—open space, recreation, esthetically pleasing surroundings, population stability? The reconciliation of such diverse objectives will not be possible until the consequences of technology can be systematically assessed, until rational siting and land use guidelines have been established, and until state and regional planning find a viable political structure.

National Environmental Quality

Ehrlich, Commoner, and other early crusaders may have been critically received, but nations are now embarking on serious, more effective pollution control programs. In the United States, the new water pollution control program has been designed to achieve use of the "best practicable" pollution control technology by 1977, the "best available" technology by 1983, and a national "no pollution discharge" goal by 1985 (*15*). The air quality program provides authority for federal control over new stationary sources of air pollution, over automotive emissions, and over all sources of air pollutants hazardous to human health (*16*). New legislation has established federal authority to limit the noise emissions of numerous corporate products (*17*); and laws to tighten up control over pesticides and hazardous materials have again been enacted (*18*).

The national commitment now authorizes control over most forms of pollution caused by technological processes, ensuring more rigorous analysis, regulation, enforcement, and citizen participation. Nevertheless, many technology-created pollution problems remain—the management and disposal of radioactive waste, toxic materials, sludge, and solid waste. In addition, new technologies such as weather modification and marine resource extraction are now being developed and experimentally applied, and they will undoubtedly create new problems and new legislation in our already "law-ridden society" (*19*, p. 32). The pattern is obvious and disturbing: the development of a technological advance, insistence upon its application by interest groups in industry and government, utilization, the appearance of environmental problems, legislation, regulation, and extensive litigation to control environmental impacts (*20*).

Assumptions

These problems of consumers, employees, communities, and nations are the results of the processes we use to develop, apply, and regulate our technology—of our methods of social control. Social control is, in turn, the result of complex interactions of underlying political, economic, and cultural forces.

What is to be done? We can continue to grapple with the problems as they crystallize, using the established and ineffective patterns of post hoc legislation, regulation, and litigation. On the other hand, we can boldly attempt to alter the underlying forces or causes, and their interactions, but this calls for information we do not have and demands an acknowledgement that the forces at work in different political systems are yielding substantially similar problems (*21*).

The most feasible strategy appears to be one of intervening in those decision-making processes of the public and private sectors that bring about technological applications; such intervention would take the form of introducing new frameworks for planning and decision-making. The development and use of coherent frameworks for technology assessment and utilization could meet many of the demands for corporate and governmental responsibility. Clearly, the use of such frameworks will affect the underlying social forces not directly confronted and will entail considerable reliance on established legal and regulatory procedures (*22, 23*).

The task of developing frameworks for technology assessment and utilization must be undertaken in full recognition of several realities.

1) Application of any such framework to a particular technological advance will yield differences in opinion and information from professionals, as well as from concerned citizens.

2) Continuing research, monitoring experiments, and changing designs will not necessarily resolve such differences, but will generally reveal the transscientific nature of decisions to be made about the further development and utilization of a specific technological advance: for example, the decisions will ultimately involve value-based consideration of the probable harm of the advance and the scope, magnitude, and acceptability of that harm (*24*).

3) Receptors—consumers, employees, and citizens generally—will find elitist decision-making and compensatory solutions to possible harmful effects inadequate, and they will actively seek to participate in the planning, design, and implementation stages of the technology application process.

4) A multiplicity of inadequate decision frameworks for technology assessment and utilization already exist and are employed by, for example, Congress, regulatory agency officials, corporate management, insurance rate-setters, courts, and organized citizen's groups.

Given this statement of the problem and these assumptions, it appears that the task is to somehow "get it all together"—to develop an understanding of how technology interacts with society and its institutions of social control; to demonstrate that citizens, corporations, and public institutions are all interrelated in specific patterns and thereby share responsibility for rational planning and decision-making; and to shape a common conceptual framework that can be readily applied by each decision-maker, in order that the different results can be compared meaningfully and used to choose knowledgeably among alternatives.

Developing a Coherent Framework

Technology is dependent upon processes that occur in four interrelated contexts: basic research, applied research, the development of prototypes for testing or experimentation, and ongoing production and utilization. Although it is difficult to pinpoint the path of any specific development, it is clear that most technology (in the form of processes, products, or techniques) in use today was brought about by the interactions of people and findings in these four contexts (*25*).

Within each context different levels and kinds of resources, or inputs are required—for example, manpower, funds, time, facilities, education, and materials—but large social and economic commitments and irreversible commitments of natural resources are

usually made only when the development and experimentation phase is undertaken. These large commitments lend an inevitability to the technological advance, because few courts and federal agencies have been willing to halt major socioeconomic commitments, irrespective of hazards to individuals or society (*26*).

The technology that emerges subsequently brings about social and environmental effects, or outputs—direct and indirect, primary and secondary, beneficial and detrimental, measurable and unmeasurable. Whether one uses nuclear power or the snowmobile as an example of current applications of technology, several classes of effects are apparent. These include effects on health (mental and physical, somatic and genetic), economy (individual and corporate, local and national, international), environment (pollution, disruptions of ecosystems), resources (availability of materials, land, and waters for competing uses), values (changes that are ultimately reflected in new law and policy), and sociopolitical institutions and processes (structural and substantive changes). As these and other effects are aggregated, they determine the quality of life.

We have no quantifiable information on many of these effects; nor can we accurately predict potential effects, their synergism, or the intervention of exogenous forces such as population migration or natural disasters. We do not have devices sophisticated enough to monitor and assess many of these effects, nor do we have articulated goals or indices to measure progress toward such goals (*23*). Decisions on goals, indices, and effects are now, and will probably always remain, transscientific.

But we have learned one thing well —that impacts and amenities which are unmeasurable or unquantifiable are nevertheless real and should be as integral to decision-making as quantifiable technical and economic considerations. At the federal level, this has been clearly expressed in the National Environmental Policy Act (NEPA) of 1969 (*27*), which requires that "unquantified environmental amenities and values" be considered along with technological and economic or quantitative inputs to public agency decision-making on projects, permits, contracts, and other major actions when such actions are likely to result in significant environmental impacts. Agencies are now struggling with this new requirement as they develop environmental impact assessments, which are subsequently exposed to the public for review before agency action. Public response to over 3000 impact statements during the past 2 years has ranged from acquiescence, to intervention in agency proceedings, to political pressure, to extensive litigation (*28*).

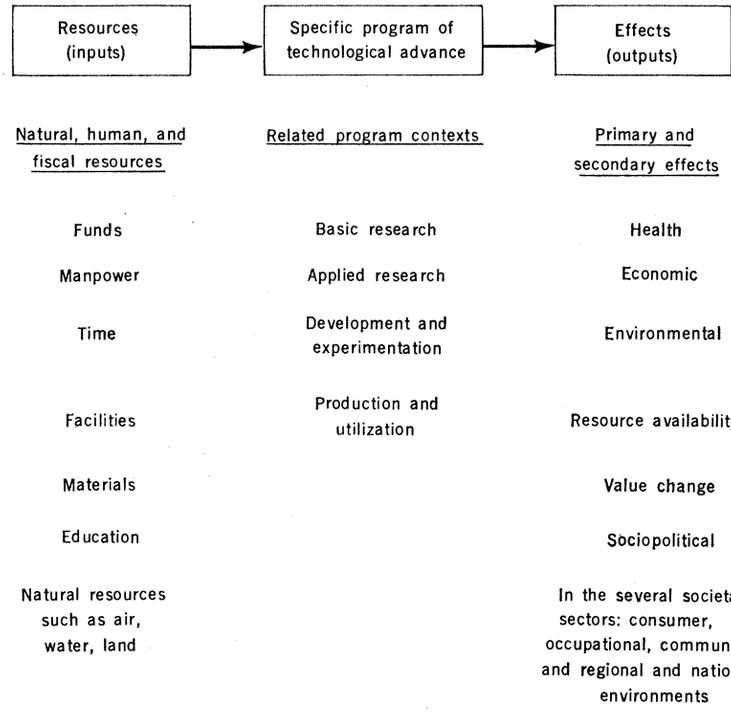

Fig. 1. Resources (inputs) and effects (outputs) of technological developments.

Following this brief discussion of inputs to and outputs of the process of technological advance, a simple model can be developed which relates a specific technological development to resources (inputs) and effects (outputs) (Fig. 1).

The implementation of each program will depend on a variety of decision-makers in both public and private sectors and at varying jurisdictional levels—local, state, regional, and federal. These decision-makers function as controls on any program in essentially two ways (Fig. 2): (i) *by controlling resources* (for example, public and private sources of manpower and funds for research and development; land use and natural resource authorities; federal and state legislatures, whose enactments may be essential to the availability of other program resources; and educators, who determine training programs) and (ii) *by controlling the detrimental effects* (for ex-

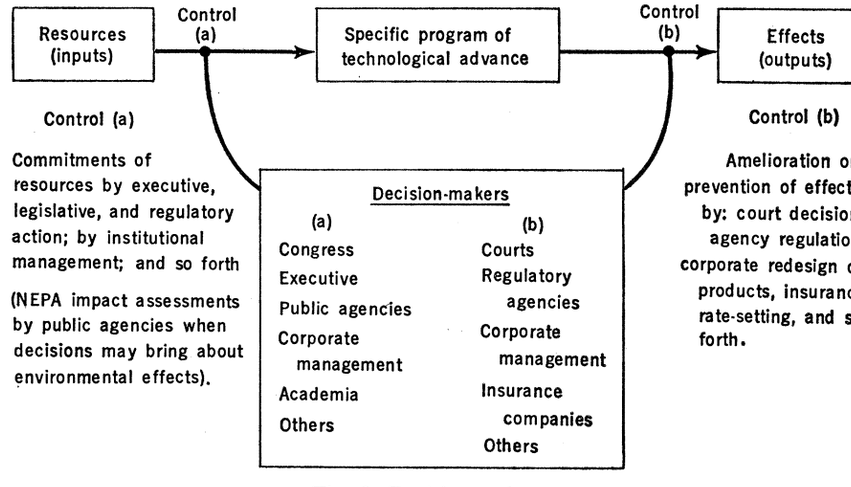

Fig. 2. Decision-makers.

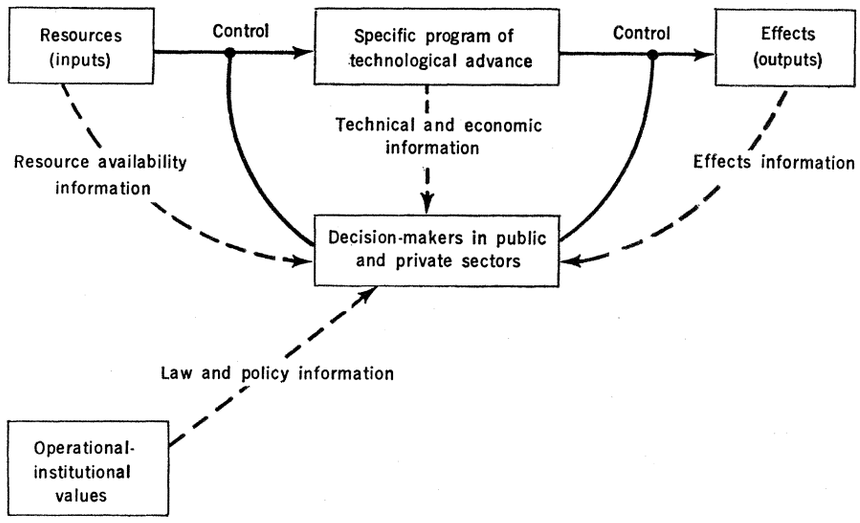

Fig. 3. Information flows to decision-makers.

ample, the courts by means of preliminary or permanent injunctions or awards of compensatory damages; federal agencies, such as the Food and Drug Administration and the Environmental Protection Agency, and their state counterparts by engaging in standard-setting, regulation, and enforcement; and program managers, corporate management, and insurance rate-setters by bringing about program or product redesign to abate or ameliorate specific effects).

To further develop this model, some of the major influences on decision-makers who control technological developments must be determined. These influences (Fig. 3) include information on: (i) resource availability; (ii) technical and economic feasibility; (iii) actual and potential effects; and (iv) operational-institutional values, which are comprised of the common law, legislation, economic and social policy, institutional management policies, and other "given" values that have been recognized and accepted by decision-makers as of the time any specific decision is made regarding further program development. These include diverse and often conflicting laws and policies—for example, NEPA (to foster the conservation and rational use of resources) and the oil depletion allowance (to foster rapid exploitation of resources).

To complete this general model, the social dynamics of any program of technological advance must be considered further—specifically, the responses of individual citizens and organized interest groups to perceived resource commitments and program effects (Fig. 4). These responses can be manifested through institutional procedures for changing the laws and policies that influence decision-makers—a lengthy process requiring extensive aggregation of voters or shareholders and generally undertaken in order to influence future decisions, not the particular decision that provoked the response.

Responses can also be manifested through formal, adversarial procedures to challenge decision-making—for example, injured consumers can go to court and disturbed environmentalists can intervene in agency proceedings or seek judicial review of agency decisions. Finally, a variety of informal procedures can be employed to feed back responses to decision-makers—such as demonstrations, employee absenteeism, product boycotts, consumer choice, or quasipolitical campaigns. The environmental and consumer protection movements serve as vivid examples of these new pressures on decision-makers, pressures new only in their intensity.

Citizens responding to perceived detrimental effects or resource misuse comprise a diverse group of consumers, shareholders, unions, crusaders, and citizens' organizations, ranging from those with national objectives (for example, the Sierra Club) to those with local or self-interest objectives (for example, labor unions, airport neighbors). The responses manifested through institutional, formal-adversarial, or informal procedures for exerting pressure on decision-makers may, in time, become so widespread or aggregated that they will be incorporated into the common law or form the basis for new management policy or legislation and, as such, become part of the matrix of operational-institutional values. This has already occurred to a considerable extent with regard to environmental and consumer protection responses.

Although the sector of society that responds adversely to the effects of a specific technological development does not normally constitute a democratic majority in its early stages, the issues raised by such responses deserve serious consideration, and the procedures for eliciting such responses are being strengthened by the courts and legislatures. First, the responses represent new perceptions, new "pieces of the truth" that were either unkown to, ignored, or lightly considered by deci-

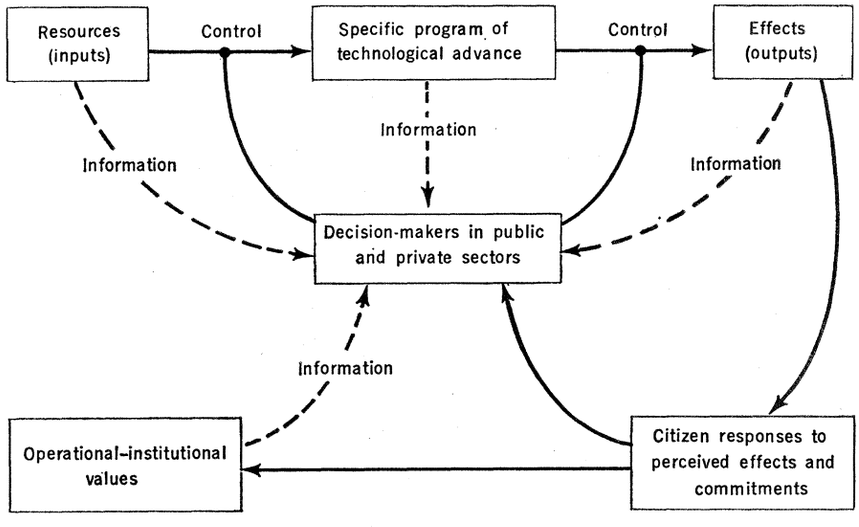

Fig. 4. Summary of influences on decision-making.

sion-makers. Second, they represent market and political influence that can be magnified by use of the media. Third, although they may be ignored at first, these responses will continue to appear in various forms and may bring about delays that are more costly after a program has been started (the utilities and the Atomic Energy Commission, for example, are now finding this out as they attempt to further the nuclear power program: plant construction and operation are running more than 2 years behind schedule, with greatly increased costs, because of extensive litigation and hearings (*29*), which resulted from an earlier failure to consider citizens' concern about thermal and radioactive waste disposal, reactor safety, and related ecological and health issues. Fourth, such responses are based on real concerns, will often find larger public support, and eventually could result in stringent legislation or judicial findings that decision-makers would have to live with (*30*).

Finally, a citizenry that expresses a diversity of interests is the most effective mode of promoting the accountability of decision-makers to the full social context in which they operate. Too often, decision-makers in all institutions have failed to inform the public about the bases and risks of decisions, thereby precluding feedback of larger social issues and humanistic concerns in their effort to promote institutional or self-interest objectives (*31*). But the benefits of an informed and responsive public have now been adequately demonstrated. Cars will be cleaner by 1975; the Army Corps of Engineers will not continue to dam rivers and spend public funds without more rigorous analysis of impacts and needs; the Food and Drug Administration will begin informing the public of the chemical contents and quality control criteria of specific consumer products they regulate; maximum permissible exposures of workers and the public to power-plant radiation have been falling. These are some of the recent "accountability" benefits that are being derived from public pressure.

Decision-making in both public and private institutions supporting technological programs and applications is becoming more complicated and less efficient, in the institutional, short-term sense; but long-term efficiencies, in terms of larger social interests such as public health, can be expected. In more pragmatic economic and political terms, it has become increasingly apparent that it is in the long-term self-interest of decision-makers and their institutions to be open and responsive to the interests of the public. As David Rockefeller has defined the issue for the private sector (*32*):

> The question really comes down to this: Will business leaders seize the initiative to make necessary changes and take on new responsibilities voluntarily, or will they wait until these are thrust upon them by law? Some adjustments are inevitable . . . there may have to be new laws to force consideration of the quality-of-life dimension so that more socially responsive firms will not suffer a competitive disadvantage. It is up to the businessman to make common cause with other reformers . . . to initiate necessary reforms that will make it possible for business to continue to function in a new climate as a constructive force in our society.

In the public sector, opposition to projects and the failing credibility of programs have prompted several agencies to increase citizen participation in program planning and design—beyond the environmental impact statement requirements of NEPA (*33*).

The model I have presented (Fig. 4) does not provide any answers, but it can be used for several purposes: to widen the perceptions of planners, designers, and decision-makers responsibile for specific technological advances and applications; to depict the interrelationships of resources, effects, decision-makers, institutions, and citizens; to develop policy, management, or program alternatives in the corporate, congressional, and public agency sectors that support and regulate technological development and utilization; and to assess, with public participation, the impacts of technological developments before they are utilized. Above all, the model articulates an accounting system, or framework, for decision-making that is dynamic and that can be used by all of the decision-makers, irrespective of their interests. The model has also proved helpful in the development of curricula and research: by making possible the ordering and integration of diverse perspectives and events and by providing an understanding of the patterns of technological development, application, and impacts, as well as social responses to technology. This understanding extends to technology in general, as well as to developments in such specific areas as mariculture, housing, and bioengineering (*34*).

Reforms in Process

A number of recent legal developments can be related directly to the model, particularly to the sector designated "citizen responses to perceived effects and commitments" of technology. For citizen responses to be responsible, the flow of information to the public about effects and commitments —actual and potential—must be coherent and balanced, and it must present alternatives with their uncertainties in comparable terms. For citizen responses to be meaningful, the processes of planning, design, and decision-making must be accessible to citizens and open to their concerns.

For example, NEPA requires federal agencies to assess environmental impacts before "major actions" are taken. These actions range from the Atomic Energy Commission's approval of a construction license for a nuclear plant to be built by a utility, to the funding of increments of the highway program by the Department of Transportation, to authorization by the Department of Agriculture for the use of herbicides and pesticides. The responsibility for assessment is broad and must include full consideration of five issues (*35*):

1) potential environmental impacts,
2) unavoidable adverse impacts,
3) irreversible commitments of resources,
4) short-term use considerations versus long-term resource needs, and
5) alternatives to the proposed action.

Draft and final impact assessments are made available to other governmental officials and to the public for review and further development under guidelines established by the Council on Environmental Quality (*36, 37*). Although NEPA does not provide veto power to any official, even if the project poses real environmental hazards, the act does provide new information to the public—by exposing the extent to which environmental effects are being considered by the agency—and provides an enlarged record for judicial review of agency decisions. Obvious deficiencies in an agency's procedure, the scope of its statement, or the content of its statement will, on the basis of experience since NEPA was enacted, result in citizen intervention in agency processes, political opposition, and litigation. Many projects proposed and assessed have been delayed, and, in some cases, projects have

been abandoned. Other projects have proceeded after being redesigned to ameliorate those effects on the environment that generated controversy (*23*, pp. 221–267).

Most projects involve applications of existing technology, but a few involve the development of new technologies—for example, the Department of Transportation's air cushion vehicle, the Atomic Energy Commission's liquid metal fast breeder reactor, cloud seeding experiments of the National Science Foundation and the National Oceanographic and Atmospheric Administration, and the use of polyvinylchloride containers, to be approved by the Internal Revenue Service, for alcoholic beverages (*38*).

NEPA does not expressly require consideration of social, health, or economic impacts or of secondary effects such as subsequent population migration and land development. These considerations are frequently ignored or treated in cursory fashion, even though they are integral to comprehensive assessment of project impacts and decision-making. NEPA does not impose assessment and exposure processes on industry or the private sector, but, whenever a utility, corporation, or other private institution is the applicant or intended beneficiary of federal agency funds, license, or other "major action," its proposal is subject to the NEPA process. There have been suggestions that NEPA be extended directly to the private sector, but as yet these have not been seriously considered at the federal level. However, variants of NEPA have been adopted by several states, and more states are expected to follow suit (*39*). Because of state and local control of land use, state versions of NEPA have the potential for directly affecting land development activities in the private sector. This potential has been realized in California, where the state supreme court has determined that the state's Environmental Quality Act requires county boards of supervisors to conduct environmental assessments before issuing building permits for housing projects and other land developments to the private sector (*40*). Similar requirements may apply to the private sector in Massachusetts, where the new environmental assessment requirements are imposed on "political subdivisions" as well as on state agencies and officials (*41*).

Therefore, the model can be further developed by adding environmental impact assessments by public decision-makers at the point where resources are to be committed to certain types of projects that apply "old" technology, as well as to certain activities that will involve the further advance or application of new technology. Concomitantly, the flow of information to citizens has been enhanced.

The development of impact statements is a meaningless exercise unless they are actually used in decision-making (*42*). It is difficult to use impact statements because of the diversity and the essentially unquantifiable nature of the new factors they present—since most agency decision-making depends on quantification of technical and economic factors (*37*). The use of impact statements in the last stage of a project, such as the awarding of construction contracts, is deceptive. The earlier stages of planning and design may not have included assessment, thereby precluding citizen inputs at a time when more important changes in project plans and alternatives could have been accomplished. In other words, effective use of impact assessment techniques and citizen feedback can be more readily achieved in the earlier, less tangible stages of a project—precisely when most agencies prefer to plan and design without public intervention. Hopefully, litigation and subsequent judicial review will impose the NEPA framework earlier in agency processes (*43*).

Further difficulties with the NEPA process have become apparent. There is an inherent conflict in the requirement that the agency proponent of a project assess it and discuss alternatives. After all, the agency has already selected an alternative and has undertaken the impact assessment essentially to justify its choice. Subsequent discussion of alternatives is too often a superficial process of setting up "straw alternatives" for facile criticism. Clearly, independent review of all the alternatives, including the proposed agency action, would be desirable. However, independent review would also require the structuring of new agency procedures and independent institutions for assessment (*44*).

Finally, the problem of dealing with unquantifiable impacts remains. The assignment of values and weights to environmental and social amenities may either be arbitrary or intentionally designed to produce decisions that had been predetermined by agency officials.

Despite these difficulties and the numerous conflicts and increased costs that now attend agency programs, NEPA is slowly forcing wiser environmental practices, more sensitive agency bureaucracies, and more effective roles for citizens. It is possible that the NEPA process could eventually provide the basis, not for conflict in the courtroom or at agency hearings, but for negotiation in good faith between interested parties over points of dispute as revealed by the environmental assessment (*45*). The resolution of labor-management conflicts under the National Labor Relations Board provides useful experience that should be reviewed for possible application to the NEPA context.

A major extension of NEPA practices to the assessment of new technology may have been accomplished with the passage of the Technology Assessment Act of 1972 (*46*). This law established within the legislative branch an Office of Technology Assessment (OTA) to ". . . provide early indications of the probable beneficial and adverse impacts of the applications of technology and to develop other coordinate information which may assist the Congress. . . ." The office is required to undertake several tasks (*46*, sect. 3):

> 1) identifying existing or probable impacts of technology or technological programs;
> 2) where possible, ascertaining cause and effect relationships;
> 3) identifying alternative technological methods of implementing specific programs;
> 4) identifying alternative programs for achieving requisite goals;
> 5) estimating and comparing the impacts of alternative methods and programs;
> 6) presenting findings of completed analyses to the appropriate legislative authorities;
> 7) identifying areas where additional research or data collection is required . . .;
> 8) undertaking . . . additional associated activities. . . .

Assessments to be carried out ". . . shall be made available to the initiating . . . or other appropriate committees of the Congress . . . [and] may be made available to the public . . ." (*46*).

The law does not distinguish between technological developments in the public agency and private sectors and presumably includes technology being developed with private funds. Although provided with the authority to sub-

poena witnesses, OTA ". . . shall not, itself, operate any laboratories, pilot plants, or test facilities." The broad language of the assessment requirements and the way in which assessments are used by Congress effectively preclude a substantial replication of the litigation and other conflicts that have characterized the NEPA experience.

Political conditions will inevitably determine the initiation of OTA studies and their use by congressional committees, and it appears that the public will, in general, be unable to secure judicial review to promote accountability of OTA and Congress.

The burden of formulating guidelines to describe when OTA should be called upon by Congress and prescribing procedures for providing information to the public clearly lies with the OTA board and advisory council. Above all, it appears essential that OTA develop and articulate a coherent framework for all technology assessments to be undertaken. Such a framework would prevent OTA assessments from becoming skillfully contrived, ad hoc case studies, which would be essentially closed to the introduction of important information from citizens and interest groups. OTA therefore has the additional burden of laying out a framework that will replace the multiple, partial models employed by different interests, that will promote inputs from interdisciplinary and humanistic sources, and that will clearly present, in a replicable format, the quantifiable and unquantifiable costs and benefits of new technological developments and applications.

Procedures to enhance the flow of balanced information on technological developments to the public will inevitably face the problem of information manipulation and secrecy practices (*47*).

> The public's need for information is especially great in the field of science and technology, for the growth of specialized scientific knowledge threatens to outstrip our collective ability to control its effects on our lives.

Secrecy on the part of public agencies and the executive branch is still common practice to protect decision-making processes from public criticism, despite the 1967 Freedom of Information Act (*48*). However, sustained public pressures for the release of nonclassified information have made such secrecy more controversial and somewhat more difficult to justify. The recent passage of the Federal Advisory Committee Act may bring about the diminution of another important form of secrecy in the public sector—agency advisory committee proceedings and recommendations, which are used in setting standards and other decision processes (*49*).

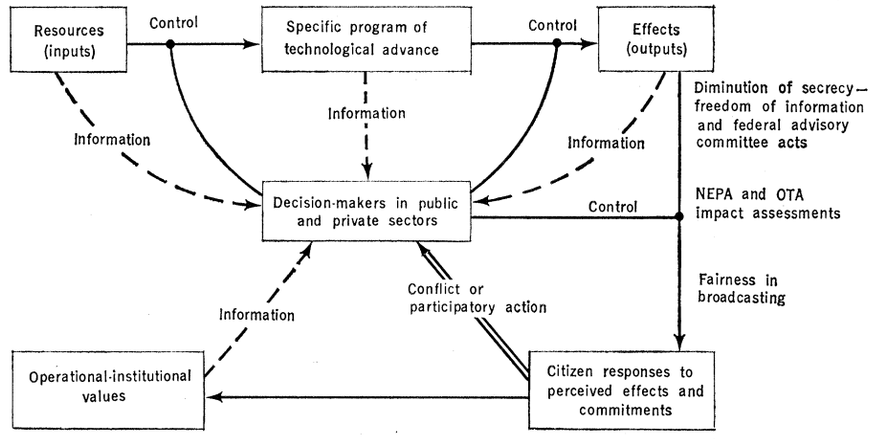

Fig. 5. Summary of influences and recent developments for decision-making.

The common law of trade secrets is similarly invoked to protect corporate information—presumably from the competition (the common law basis for the concept) (*50*), but increasingly from the public and government. The Environmental Protection Agency has been unable to secure information on the quantities of polychlorinated biphenyls (PCB's) made and sold by the one American manufacturer, despite evidence that PCB's are now part of the international pollution problem (*51*). In other industrial technology sectors, however, congressional legislation has provided the government with access to information and procedures normally cloaked by trade secrecy. For example, section 206(c) of the Clean Air Act (*16*) provides that the Environmental Protection Agency may:

> . . . enter at reasonable times, any plant or other establishment of such [auto engine] manufacturer, for the purpose of conducting tests of vehicles or engines in the hands of the manufacturer or . . . to inspect . . . records, files, papers, processes, controls, and facilities used by such manufacturer in conducting tests . . . [regarding motor vehicle and engine compliance with EPA regulations].

A similar section in the 1972 Water Pollution Control Act (*15*, sect. 308) also provides the Environmental Protection Agency access to secret information held by water polluters. It appears that Congress is now aware of trade secrecy as an obstruction to pollution control and is willing to begin limiting the antisocial uses of secrecy to some extent.

Finally, trade secrecy, in its present forms, will certainly obstruct the development of meaningful "corporate social audits" that David Rockefeller and other industrial leaders have called for. Legal sanctions for corporate secrecy obviously must be challenged if corporate responsibility and technology assessment are to be realized.

Beyond secrecy lies the problem of corporate advertising for new products and technological processes. Here, too, developments in the courts and regulatory agencies indicate that better information must be provided the public. The rapid evolution of the "Fairness Doctrine" now means that radio and television broadcast licensees must make reasonable and fair presentations of the contrasting sides of a controversial issue, once such issue has been raised (usually by advertising) on licensee broadcast time. As expressed in a recent law review note: "This obligation is incurred even at the licensee's expense if no sponsorship is available . . . [although] the licensee has discretion to determine how the contrasting sides will be presented and who will be the spokesman" (*52*, p. 109).

The doctrine has been applied by federal courts to cases of product advertising (cigarettes, large-engine automobiles, and high-test gasolines) in which it was felt that only one side of a controversial issue—the effect of such products on public health—was being presented by Federal Communications Commission (FCC) licensees in the form of advertisements. In the case of

cigarettes, Banzhaff *v.* FCC (*53*), the court noted that its ruling for equal time for countercommercials or presentations promoted the first amendment policy of fostering the widest possible debate and dissemination of information on matters of public importance. In the case of commercials for automobiles and high-octane gasolines, the court noted, "When . . . the hazards to health implicit in air pollution are enlarged and aggravated by such products, then the parallel with cigarette advertising is exact . . ." (*54*) and ignored possible impacts on advertising and licensees as it sent the case back to the FCC for redetermination.

The idea that broadcast licensees should present balanced information on advertised but controversial technological processes or products is now a reality. Once again, the flow of information to the public, as indicated on the model (Fig. 5), is being enhanced and new corporate attitudes and advertising practices should follow. (The NEPA, OTA, secrecy, and "Fairness" developments can now be depicted on the model.)

How will this enhanced flow of information be used by citizens responding to the effects of technology? What will be the nature and forms of the resulting new pressures on decision-makers?

On the model, the broad arrow from citizens to decision-makers represents not a flow of information, but adversarial processes in courts and agency proceedings. For decision-makers to learn from an endless series of adversarial processes is a slow, costly, and painful task that benefits only lawyers. The task facing the public sector and corporate decision-makers who are responsible for applications of technology is to transform this relationship from an adversarial one to one of joint decision-making and negotiation of differences in good faith among all interested parties—in short, to establish an ongoing dialogue and joint effort at assessing and planning the uses of technology (*55*). This effort will require new institutional management procedures, the development of more sophisticated assessment techniques, the articulation of assumptions by decision-makers, an opening up of project or program planning and design stages, and, ultimately, structural and substantive changes in the political system.

"Who speaks for the public?" will become a central issue—one that the federal agencies and the courts are now grappling with in the context of NEPA (*56*). Perhaps technology itself may provide some assistance here. Citizen-feedback technology exists, has been used experimentally, and has demonstrated a remarkable potential for both informing citizens and eliciting opinions and information useful for decision-making (*57*). The enhanced process orientation that could result from applications of the recommended model, improved information flow, and new citizen-feedback techniques would ensure continuing recognition in decision-making of the pervasive social impacts of technology.

Can these numerous, fragmented developments in technology and in our legal and political systems be integrated into a coherent framework for the social control of technology? It has been noted that (*58*, p. 729):

> . . . two major intellectual developments of the 17th century occurred almost simultaneously in law and science. The first was the drive for systematic arrangements and presentation of existing knowledge into scientifically organized categories . . . the second . . . was the concern with degrees of certainty or . . . probability. . . . By the end of the 17th century . . . traditional views . . . had been upset and new methods of determining truth and investigating the natural world had replaced those that had been accepted for centuries . . . there was a strong movement toward arranging both concepts and data into some rational ordering that could be easily communicated and fitted into the materials of other fields so that a universal knowledge might emerge . . . traditions of legal history and legal argumentation that assume the law's autonomous march through history are seriously in need of correction. . . .

It is now time to replicate this experience, develop a coherent framework for the social control of technology, and ensure that forthcoming processes of technology assessment and utilization will be systematic and humane.

References and Notes

1. *Final Report of National Commission on Product Safety* (Government Printing Office, Washington, D.C., 1970), pp. 73–79.
2. Public Law 92-573 (1972).
3. *U.S. Law Week.* **41** (No. 16), p. 1061 (1972).
4. See, for example, J. Sweet, in *Legal Aspects of Architecture, Engineering and the Construction Process* (West, St. Paul, Minn., 1970), sect. 30.07, pp. 634–637.
5. 29 U.S. Code 151.
6. 29 U.S. Code 651. See *Job Safety and Health Act of 1970* (Bureau of National Affairs, Washington, D.C., 1971) for collection of relevant materials.
7. D. Cordtz, *Fortune* (November 1972), p. 112.
8. As discussed by F. Grad, in *Environmental Law* (Bender, New York, 1971), pp. 1–115.
9. *Harv. Law Rev.* **84**, 1822 (1971).
10. Coverage in the media has been extensive. See the 1971 and 1972 issues of *London Observer* and *New York Times*—for example, *New York Times* (7 March 1972), p. 17.
11. *Man's Health and the Environment* (Department of Health, Education, and Welfare, Washington, D.C., 1970), pp. 97–125.
12. Boomer *v.* Atlantic Cement Co., 26 New York 2nd ser. 219, 257 New Eng. 2nd ser. 870 (1970) provides a classic example of judicial caution.
13. See "Economic dislocation early warning system reports" of the Environmental Protection Agency, Washington, D.C. (mimeographed).
14. Note, for example, the numerous requests for variances from air pollution control requirements by industry and chambers of commerce that are now being processed and granted.
15. Public Law 92-500 (1972).
16. 42 U.S. Code 1857, as amended by Public Law 90-148 (1967), Public Law 91-604 (1970), and Public Law 92-157 (1971).
17. Public Law 92-574 (1972).
18. Public Law 92-516 (1972).
19. *Legal Systems for Environment Protection*, legislative study No. 4 (U.N. Food and Agriculture Organization, Rome, 1972), pp. 23–32.
20. Congressional recognition of the relationship between technological advance and environmental deterioration is expressed in Title I, Section 101(a) of Public Law 91-190 (1970).
21. C. S. Russell and H. H. Landsberg, *Science* **172**, 1307 (1971); M. I. Goldman, *Science* **170**, 37 (1970).
22. The Council on Environmental Quality has partially defined the task (*23*, p. 343): "The contemporary world is to a great extent determined by technology. . . . The scale and speed of technological change may well have outstripped the ability of our institutions to control and shape the human environment. . . . It is important to understand the emerging technologies of the future and their implications for the environment and our way of life. . . . Predicting what and how new technologies will shape the future is a difficult task. . . . Even more difficult than predicting future technological developments is assessing what the full impact of any particular technology will be. . . . Despite the difficulties of assessing technology, it is essential that it be done. . . . We must develop the institutional mechanisms capable of making technology assessments. . . ." Implicit in the council's proposal is the need for new methods to be employed in the development of assessments and the need for assurance that such assessments will indeed be used in decision-making in relevant public and private institutions.
23. Council on Environmental Quality, *Environmental Quality: Third Annual Report* (Government Printing Office, Washington, D.C., 1972).
24. A. Weinberg, *Science* **177**, 27 (1972).
25. See, for example, *Technology in Retrospect and Critical Events in Science* (National Science Foundation, Washington, D.C., 1968).
26. B. Portnoy, *Cornell Law Rev.* **55**, 861 (1970).
27. 42 U.S. Code 4321.
28. See *102 Monitor*, the monthly report of the Council on Environmental Quality, for listings of environmental impact assessments and periodic reviews of litigation related to NEPA. Also see (*23*, pp. 221–267) for a comprehensive survey of NEPA implementation.
29. No data available at this time. Statement based on conversations with professionals familiar with nuclear power program.
30. See, for example, Calvert Cliffs Coordinating Committee *v.* Atomic Energy Commission, 449 Fed. Rep., 2nd ser. 1109 (D.C. Cir. Ct. 1971).
31. As Senator Sam Ervin (D–N.C.) has said: "When the people do not know what their government is doing, those who govern are not accountable for their actions—and accountability is basic to the democratic system. By using devices of secrecy, the government attains the power to 'manage' the news and through it to manipulate public opinion. Such power is not consonant with a nation of free men . . . and the ramifications of a growing policy of governmental secrecy is extremely dangerous to our liberty" [*The Nation* (8 November 1971), p. 456].
32. Boston *Globe* (5 May 1972), p. 17.
33. See *Congr. Rec.*, 5 October 1972, p. 517059, regarding the Corps of Engineers and *Policy and Procedure Memorandum 90-4* (Department of Transportation, Washington, D.C., 1972) regarding the federal highway program.
34. The model is being used in the presentation of "Law and the social control of science

and technology" and "Legal aspects of environmental quality," two graduate courses, and in several research projects at M.I.T. by the author.

35. Public Law 91-190 (1970), sect. 102 (2) (c).
36. *Fed. Reg.* **36**, 7724 (23 April 1971).
37. Council on Environmental Quality, "Memorandum for agency and general counsel liaison on NEPA matters" (mimeographed), 16 May 1972.
38. See the *102 Monitor* of the Council on Environmental Quality for abstracts of draft and final impact assessments, some of which grapple with new technological developments.
39. See *102 Monitor* **1** (No. 6), 1 (July 1971) for action by six jurisdictions. Since this review, Massachusetts has adopted its version of NEPA: Chap. 781 of Massachusetts Acts of 1972, amending Chap. 30 of Massachusetts General Laws. Connecticut is now considering similar action.
40. Friends of Mammoth *v.* Mono County, 4 Environ. Rep. Cases 1593, Calif. S. Ct. (1972).
41. Chap. 30, Massachusetts General Laws, sect. 62.
42. In Calvert Cliffs Coordinating Committee *v.* AEC (*30*), the court's ruling included discussion of the "balancing process" that agencies must undertake in project decision-making to comply fully with NEPA, in addition to procedural compliance in the development of impact assessment: "The sort of consideration of environmental values which NEPA compels is clarified in Section 102(2) (A) and (B). In general, all agencies must use a 'systematic, interdisciplinary approach' to environmental planning and evaluation 'in decision-making which may have an impact on man's environment.' In order to include all possible environmental factors in the decisional equation, agencies must 'identify and develop methods and procedures . . . which will insure that presently unquantified environmental amenities and values be given appropriate consideration in decision-making along with economic and technical considerations.' 'Environmental amenities' will often be in conflict with 'economic and technical considerations.' To 'consider' the former 'along with' the latter must involve a balancing process. In some instances environmental costs may outweigh economic and technical benefits and in other instances they may not. But NEPA mandates a rather finely tuned and 'systematic' balancing analysis in each instance."
43. See, for example, Stop H-3 Association *v.* Volpe, 4 Environ. Rep. Cases 1684 (1972), where the U.S. District Court for Hawaii held that highway project design work and further test borings be enjoined until an impact assessment has been developed and used, since such work "would increase the stake which . . . agencies already have in the [project]" and reduce any subsequent consideration of alternatives.
44. M. Baram and G. Barney, *Technol. Rev.* **73** (No. 7), 48 (1971).
45. The "Leopold Matrix" is a useful mechanism for promoting rational discussion and systemic resolution of project impacts by the proponents and opponents of a project in a nonadversarial setting. The matrix disaggregates impacts, calls for designation of probability of magnitude and signficance of each impact, and can be completed by each of the interested parties in a project controversy. Comparative analysis of the results reveals important areas of difference of opinion and enables the parties to consider a variety of strategies for reducing these differences, such as design change or the need for concurrent projects to offset specific impacts. For example, waste water from a housing project may be one of the bases for community opposition, yet state and federal funds and programs may be available to reduce the problem. See *A Procedure for Evaluating Environmental Impact*, circular No. 645 (U.S. Geological Survey, Washington, D.C., 1971). Also see P. Bereano (unpublished manuscript, 1971) for application of the "Leopold Matrix" to technology assessment.
46. Public Law 92-484 (1972). For the text of the bill and relevant background, see U.S. Senate, Committee on Rules and Administration, subcommittee on computer services, *Office of Technology Assessment for the Congress* (92nd Congr. 2nd sess., 2 March 1972).
47. Soucie *v.* David, 2 Environ. Rep. Cases 1626 (D.C. Cir. Ct., 1971).
48. 5 U.S. Code 552.
49. Public Law 92-463 (1972) and Executive Order 11686 (1972). Also see U.S. House of Representatives, committee on Government Operations, *Advisory Committees* (92nd Congr., 2nd sess., 4 November 1971).
50. M. Baram, *Harv. Bus. Rev.* **46** (No. 6), 66 (1968).
51. *Chlorinated Hydrocarbons in the Marine Environment* (National Academy of Sciences, Washington, D.C., 1971), p. 17: "Recommendation: Removal of obstacles to public access to chemical production data. Among the causes contributing to the lack of available data on the chlorinated hydrocarbons is a legal structure that allows manufactures of a given material, when there are no more than two producers, the right to hold their production figures as privileged information.* The panel recognizes the economic rationale that deters the release of production figures by such manufacturers and understands that our government is charged by law with the protection of their proprietary interest. Indeed, we approve the principle that governmental action should not artificially affect competition. However, we also feel that there are times when it is not in the public interest for government to maintain as privileged data that are necessary for research into the state of our environment and for an assessment of its condition. In that regard, we recognize the possibility that it is not always competitive concerns alone that determine the less than candid posture assumed by industry concerning production figures. We recommend that the laws relating to the registration of chemical substances and to the release of production figures by the Department of Commerce and the Bureau of the Census be reexamined and revised in the light of existing evidence of environmental deterioration. The protection afforded manufacturers by government is an artificial obstacle to effective environmental management, particularly with reference to the polychlorinated hydrocarbons. In view of other impediments—technological, methodological, and financial—such protection is clearly inappropriate."

    * For example, the Monsanto Chemical Company has refused to release its production figures for PCB's, although requested to do so by many scientists and government officials."
52. B. Wiggins, *Natur. Resour. J.* **12** (No. 1), 108 (1972).
53. 405 Fed. Rep. 2nd ser. 1082 (1968); certiorari denied, 396 Supreme Ct. 824 (1969).
54. Frends of the Earth *v.* Federal Communications Commission, 2 Environ. Rep. Cases 1900 (D.C. Cir. Ct., 1971).
55. Of course, the achievement of a consensus is not sufficient to ensure responsible decisions: there must also be an integration of technical perspectives on long-term material and individual needs, which may have been ignored by the parties to the consensus. Such needs are usually too remote (for example, teratogenic effects) or hidden (for example, ground water depletion) to be accorded full consideration by project proponents and citizen adversaries.
56. See Sierra Club *v.* Morton, 45 Supreme Ct. 727 (1972), wherein the Supreme Court provided the latest answer to when ". . . a party has a sufficient stake in an otherwise justiciable controversy to obtain judicial resolution of that controversy. . . ." The court noted that injury other than economic harm is sufficient to bring a person within the zone of standing; that merely because an injury is widely shared by the public does not preclude an individual from asserting it as a basis for personal standing; that injury sufficient for standing can include esthetic, conservational, and recreational injury, as well as economic and health injury. But the court noted that ". . . broadening the categories of injury that may be alleged in support of standing is a different matter from abandoning the requirement that the party seeking review must have himself suffered the injury . . ." and that ". . . a party seeking review must allege facts showing that he is himself adversely affected . . ." in order to prevent litigation by those ". . . who seek to do no more than vindicate their value preferences through the judicial process."
57. T. Sheridan, "Technology for group dialogue and social choice," M.I.T. report to the National Science Foundation on grant GT-16, "Citizen feedback and opinion formulation," 1971; and D. Ducsik, N. Lemmelshtrich, M. Goldsmith, E. Jochem, "Class exercise simulating community participation in decision-making on large projects: radiation case study" (unpublished manuscript, 1972).
58. B. Shapiro, *Stanford Law Rev.* **21**, 727 (1969).
59. I wish to thank Dennis W. Ducsik, a doctoral candidate in the department of civil engineering at M.I.T. who is pursuing an interdisciplinary program in environmental resource management and technology assessment, for his help as a research assistant in the project and in the development of this article. I also wish to acknowledge the support of the National Endowment for the Humanities (grant No. EO-5809-71-265).