The Fifth Branch

Science Advisers as Policymakers

Sheila Jasanoff

Harvard University Press
Cambridge, Massachusetts
London, England

Contents

1

Rationalizing Politics

Scientific advisory committees occupy a curiously sheltered position in the landscape of American regulatory politics. In an era of bitter ideological confrontations, their role in policymaking has gone largely unobserved and unchallenged. Advisory committees are generally perceived as an indispensable aid to policymakers across a wide range of technical decisions. They offer a flexible, low-cost means for government officials to consult with knowledgeable and up-to-date practitioners in relevant scientific and technical fields, supplementing the unspecialized and sometimes pedestrian expertise available within the executive branch. Perhaps most important, they inject a much-needed strain of competence and critical intelligence into a regulatory system that otherwise seems all too vulnerable to the demands of politics. It is hardly surprising, then, that in most programs of health, safety, and environmental regulation, consultation between agencies and advisory committees has become almost routine, even when not required by law. The proposition that science-based decisions should be reviewed by independent experts strikes us today as hardly more controversial than the proposition that there is no completely risk-free technology.

Yet, given the centrality of their role in the regulatory process, the activities of scientific advisers are poorly documented and their impact on policy decisions is difficult to understand or evaluate. If a cardinal function of advisory committees is to take the politics out of policymaking, then a survey of the American regulatory scene for the past twenty years casts doubt on their efficacy. Not only were regulatory decisions during this period particularly prone to legal and political challenge, but a remarkably high percentage of the challengers targeted the quality and sufficiency of the agencies' technical arguments. Evidence of consultation with expert committees rarely proved

sufficient to silence controversy. These are some of the paradoxes that I set out to examine in this book. Why does a regulatory process so strongly committed to rational decisionmaking and use of expert knowledge so frequently fail to produce consensus over the use of science? What are the factors that inhibit scientific advisory committees, in particular, from containing or closing technical disputes? Conversely, is it possible to identify conditions under which an advisory committee's intervention will be accepted as authoritative by other players with a stake in policymaking?

In the U.S. regulatory process, support for advisory mechanisms coexists with widespread disagreements about how to select advisers, how to frame issues for their consideration, and how much weight to give to their recommendations. The absence of such agreement points to still more basic differences about allocating scientific and technical power between experts and the lay public, among competing political interest groups, and between citizens and the state. An investigation of the politics of scientific advice thus provides an avenue for exploring some of the enduring conflicts between democratic and technocratic values in this country's public and political life.

To establish the historical and analytical framework for the remainder of the book, I outline in this introductory chapter some factors that constrain the performance of modern scientific advisory committees as legitimators of public policy. I begin by describing the institutional and political environment within which advisory committees carry out their business. The recent explosive growth of scientific advising has taken place against a backdrop of growing public concern about technological hazards, accompanied by diminished trust in government and ambivalence about the place of experts in political decisionmaking. The second part of the chapter relates these problems to recent scholarly findings about the admixture of science and values in regulatory proceedings and about the contingent and negotiated character of scientific knowledge.

The Rise of Social Regulation

The changing complexion of governmental regulation in the 1970s provides part of the context in which scientific advisory committees operate. The rapid expansion of social regulation in this period created a host of new agencies and expanded the reach of federal regulatory activity across a much wider cross-section of commerce and

industry.[1] Simultaneously, the nature of technical decisionmaking in the agencies underwent profound changes. To protect the public against hazardous and environmentally harmful technologies, fledgling agencies were asked to undertake ever more complex predictive analyses of the risks and benefits of regulation. The costs of controlling risk grew in a seemingly inverse relationship to the certainty of harm. Decisions of unprecedented socioeconomic impact seemed increasingly to be based on imperfect knowledge developed by inexperienced administrators through novel and untested scientific techniques. Beginning in 1981, moreover, the Reagan administration identified government regulation as the prime impediment to technological innovation and as an important contributor to America's flagging performance in the world economy. Under these combined pressures, public faith in the professionalism and specialized expertise of regulatory agencies, and in the legitimacy of their decisions, gradually eroded.[2]

The new programs of social regulation required most policy decisions to be founded on an explicit trade-off between risks to health or the environment and the economic and social costs of regulation. Since neither side of the calculation could be precisely estimated, suspicion grew that regulators were arbitrarily overstating one or the other in order to reach predetermined results. Under these circumstances, it became difficult for agency officials—seen by many as an overly powerful fourth branch of the government—to avoid creating the impression that they were manipulating scientific knowledge and shielding fundamentally political choices behind the pronouncements of a still more inscrutable "fifth branch" of technical experts.

The perception that regulators were permitting political considerations to corrupt the integrity of their scientific analyses spread across the entire political spectrum. It was a common complaint of industry and members of the scientific community during the 1970s that the Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) had systematically distorted their assessments of cancer risk so as to build the case for more regulation. Others charged regulators with selectively using expert knowledge to enlarge their own political agendas. According to one account, for instance, the Food and Drug Administration (FDA) deliberately used inadequately validated animal studies of saccharin to propose that the artificial sweetener be banned.[3] By contrast, in the early years of the Reagan administration, environmentalists accused EPA of introducing

a pro-industry and antiregulatory bias into its principles for assessing carcinogenic risk.

The scientific credibility of the regulatory agencies was also hurt by occasional well-publicized discoveries of research fraud and misrepresentation of data. Although such cases were not numerous, some of them were flagrant enough to attract attention from Congress and the media. Beginning in 1976, the discovery that Industrial Bio-Test Laboratories (IBT), a private testing concern, had systematically falsified data on hundreds of toxicology tests sent shock waves through the regulatory establishment.[4] A five-year investigation of IBT led to criminal prosecutions against three of the company's top executives,[5] and, more seriously from the standpoint of public health, to determinations in the United States, Canada, and Sweden that numerous insecticides and herbicides registered on the basis of IBT data should be withdrawn from commercial use.

In other instances, regulatory agencies were directly implicated in charges of misconduct or incompetence in research related to public policy. EPA, for example, was seriously embarrassed by allegations of fraud in the health studies it commissioned at Love Canal. A similar problem occurred when EPA learned that the principal studies underlying a proposed air quality standard for carbon monoxide had been conducted by a scientist who was suspected of fabricating data and had been debarred from doing research for two other agencies. Allegations of scientific impropriety also helped to discredit the standard for benzene promulgated by OSHA in 1980 and were a factor in the judicial reversal of that action. Episodes such as these damaged the already fragile credibility of the agencies as scientific and technical decisionmakers.

Science and Policymaking

The role that science and scientists have played in policymaking during the past few decades provides another indispensable piece of the context for a study of contemporary scientific advisory committees. What do we actually know about the uses of science in policy decisions, and what does this suggest about the place of experts in the regulatory process?

Writing about scientific advisers back in 1964, Harvey Brooks almost casually introduced into the literature a conceptual distinction that has since served to anchor most discussions of the relationship

between science and government. The functions of advisers, Brooks suggested, can be loosely divided under the headings of "science in policy" and "policy for science":

> The first is concerned with matters that are basically political or administrative but are significantly dependent on technical factors—such as the nuclear test ban, disarmament policy, or the use of science in international relations. The second is concerned with the development of policies for the management and support of the national scientific enterprise and with the selection and evaluation of substantive scientific programs.[6]

The distinction, as Brooks himself acknowledged, does not necessarily correspond to a clear difference. Policies *for* science need input from respected scientists if they are to be regarded as credible. Similarly, social policies *in* which science plays a substantial role—clean air standards, licenses for nuclear power plants, pesticide registration, permits for genetic engineering experiments—invariably exercise a secondary impact on the nation's policies for managing its scientific and technological resources. Nonetheless, the two categories serve as useful headings for organizing the literature on scientific advising and public policy.

The need for better advisory mechanisms has frequently been noted in works dealing with policymaking for science, but such studies have tended to downplay the controversies and conflicts that arise from attempts to use scientific information in policy decisions. Characteristic of this genre is William T. Golden's massive compilation of essays on science advice to the federal government.[7] The book persuasively argued for a restoration of the President's Science Advisory Committee (PSAC) so as to ensure more systematic technical input to the nation's policies for science, especially with respect to expenditures for military and civilian research. But of the sixty-seven contributors who addressed the needs of the president and the executive branch, including several former PSAC members, not one was centrally concerned with the delivery of scientific and technical information to federal regulatory agencies.[8] Preoccupied with the problem of too little scientific advice, particularly in the sphere of presidential decisionmaking, Golden's book skirted or overlooked the complexities that arise when contested science is factored into policy.

Much more closely related to the concerns of this book is a small but growing body of work whose primary object is to illuminate the

role of science in regulatory proceedings, an area of decisionmaking that is often generically described as "science policy."[9] Contributions to this area of research emphasize the interplay of facts and values in public policies dealing with technological hazards. They also project a considerably less sanguine view of the power of science to influence and rationalize policy than was espoused by the contributors to Golden's volume.

The nature of policy-relevant science and its relationship to policy have been most instructively explored in a cluster of studies focusing on the U.S. government's efforts to regulate carcinogens in the 1970s and 1980s. In one of the few book-length treatments of the subject, Mark Rushefsky, a political scientist, noted that scientific uncertainty is a resource that can be mobilized by regulators and other actors in their efforts to influence policy.[10] In his account of the evolution of federal cancer policy, Rushefsky argued that competing interest groups use both knowledge and gaps in knowledge for instrumental purposes, specifically, to shape risk-assessment guidelines consistent with their social objectives. Dwelling on the interconnections between facts and values (or science and policy) in carcinogenic risk assessment, Rushefsky joined the rank of risk analysts who assert that the scientific component of the exercise can never be wholly separated from its value component.[11]

Liora Salter's study of standard-setting controversies in Canada diverged from Rushefsky's in choosing science itself as the object of investigation; put in slightly over-simplified terms, she asked how scientific activity is affected by standard-setting rather than the reverse.[12] She argued that "mandated science," the science used for purposes of making policy, has characteristics that distinguish it, on the whole, from science generated in pure research settings. Like Rushefsky, who spoke of "regulatory science," Salter acknowledged that mandated science differs from normal science partly because of ways in which society uses the two bodies of knowledge. But other distinctive features of mandated science, in her view, must be attributed to the fact that scientific and policy considerations are closely integrated at every step in its production and use.[13] Salter suggested that the procedures used by regulatory agencies should take into account the "mixed" nature of the science used in policymaking. Her own research indicated, however, that standard-setting processes, at least in Canada, continue to take their cue from an idealized picture of science that ignores its links to policy.

If science in the policy setting is always colored by values, then what role should scientists, who are professionally committed to impartiality, expect to play in decisionmaking? Joel Primack and Frank von Hippel, two early contributors to the field of science policy analysis, believed that the correct response was for more scientists to inject their own political values into science, but from a consciously environmental and public health perspective. Government agencies, they argued, had frequently misused, ignored, or concealed the opinions of their scientific advisers on important questions of science and technology policy.[14] To counteract these abuses, Primack and von Hippel urged the development of a stronger "public interest science" movement dedicated to exposing the uncertainties and assumptions buried in conventional expert assessments of scientific and technological developments. They also advocated more open advisory procedures, a recommendation that has since been widely implemented in the United States.

A later and less polemical work, Ted Greenwood's study of decisionmaking in EPA and OSHA, debunked the common complaint that agencies are scientifically incompetent and sought to explain perceived agency failures in terms of institutional factors.[15] Vulnerability, Greenwood suggested, is a bigger problem for U.S. regulators than incompetence. When key facts are unknown, regulatory agencies have to act on the basis of discretion rather than certain knowledge, thereby undermining the legitimacy of an administrative system that is, on the face of it, firmly committed to rational, nonarbitrary decisionmaking.[16] Greenwood suggested that more frequent consultation with advisory committees might increase the apparent competence of regulatory agencies while usefully reducing their scope for discretionary action.

Greenwood's conclusions about discretion are shared by most commentators on science policy in the regulatory agencies. It is now widely recognized that the questions regulators need to ask of science cannot in many instances be adequately answered by science.[17] There is also general agreement that, in the absence of sufficient hard evidence, decisions have to be made on the basis of available facts supplemented by a large measure of judgment.[18] Nevertheless, there is an unspoken presumption in many of the aforementioned works that better scientific characterization of a problem will lead to better policy. The validity of this basic assumption, however, has also begun to be questioned. For instance, although political conflict may be pro-

moted and sustained by scientific uncertainty, it is by no means safe to assume that reducing uncertainty automatically reduces conflict. This is the intriguing conclusion that emerged from a study of safety standards for formaldehyde and benzene (both suspected carcinogens) by John Graham, Laura Green, and Marc Roberts.[19] Their account of the way scientific debates about these two substances matured over time showed that advances in scientific knowledge do not predictably correlate with reductions or increases in policy conflict.

A possible explanation for this anomaly can be found in a number of works comparing U.S. cancer policies with those of other countries. These analyses suggest that the formal and adversarial style of American regulatory decisionmaking highlights uncertainty, polarizes scientific opinion, and prevents efficient resolution of disputes about risk.[20] Far from promoting consensus, knowledge fed into such a process risks being fractured along existing lines of discord.

Similar observations drawn from other regulatory controversies led David Collingridge and Colin Reeve, two British analysts of technology policy, to form a sweepingly negative conclusion about the capacity of scientific knowledge to advance rational policymaking.[21] Science, they asserted, always encounters an under-critical or an over-critical environment when it is linked to policy; in either case, the impact of science on policy is negligible. In the under-critical model, a policy consensus exists before new research is undertaken, ensuring too easy reception of scientific claims that appear to support the policy. In the over-critical model, by contrast, political adversaries are sharply divided and scientific claims are subjected to heightened scrutiny by experts from rival camps. The result, most often observable in the U.S. regulatory process, is endless technical debate.

The theme that emerges most forcefully from these studies is that scientific uncertainty and the pressures of decisionmaking lead to a forced marriage between science and politics. Guidelines for cancer risk assessment are a typical product of this unnatural union, an unstable policy instrument in which the balance of scientific and political considerations can disintegrate at any moment as a result of changes in either knowledge or politics.

Strangely absent from the literature, however, is the puzzle this poses for scientific advisory committees attached to regulatory agencies. If the scientific claims that these bodies are asked to evaluate are uncertain, insufficient, and inherently mixed with policy, then how can advisers selected for their technical expertise and political neu-

trality possibly certify them as valid science? Alternatively, if regulatory advisers invariably become part of a hybrid sociotechnical process, as most of the literature suggests, then how can they maintain their authority as neutral experts, especially when challenged in the media or the courts? Finally, if Collingridge and Reeve are right, then are we not forced to conclude that scientific advice is at best simply irrelevant to policy? Published accounts of science in policy thus deepen the paradox of advice and legitimacy, for by questioning whether technical advisers can ever be dispassionate, decisive, or value-neutral, they cut at the roots of the conventional justification for scientific advice.

Expertise and Trust

Assessments of the place of experts in the American administrative process are further complicated by this society's persistent ambivalence about the degree to which technocratic values should constrain the exercise of political choice. Like Yaron Ezrahi's "pragmatic rationalist,"[22] many Americans are persuaded that even the most technical policy decisions require a judicious mixture of scientific and nonscientific judgment, and there is a concomitant fear of letting experts usurp that part of decisionmaking which should be truly political. Yet an alternative view—that components of decisionmaking requiring specialized knowledge should be depoliticized and left to experts—continues to reassert itself in American politics. The technocracy movement, which flowered for a brief period between the two World Wars, gave perhaps the most extreme embodiment to these views,[23] but support for skill-centered forms of policymaking, especially on matters concerning science and technology, remains a force to be reckoned with in modern times.[24]

The oscillation between deference and skepticism toward experts can be observed at almost every stage in the rise of the modern administrative state. By the end of the nineteenth century, the notion of administrative specialization had come into vogue and it was clear to many observers that persons wielding regulatory power needed particularized experience in order to carry out their delegated responsibilities. Woodrow Wilson, for example, approved expert agencies in general terms, recognizing that regulatory tasks require "not a little wisdom, knowledge, and experience" and that "such things must be studied in order to be well done."[25]

The idea that administrators might require technical knowledge in addition to experience was perhaps slower to gain ground, but also soon found adherents among progressive thinkers. Thus, Leonard White in 1926 wrote glowingly of the government's dependence on technical experts:

> So we discover in the administrative service one official who knows all that can be known about the control of water-borne diseases, another who has at his fingertips the substance of all available information on wheat rust, and another who cannot be "stumped" on appropriations for the national park service. These men are not merely useful to legislators overwhelmed by the increasing flood of bills; they are simply indispensable. They are the government.[26]

But not everyone was equally sanguine:

> The expert knows his stuff. Society needs him, and must have him more and more as man's technical knowledge becomes more and more extensive. But history shows us that the common man is a better judge of his own needs in the long run than any cult of experts.[27]

A more elaborate critique of experts in government developed in connection with studies of the independent regulatory commissions in the 1930s and 1940s. The Brownlow Committee report of 1937 expressed misgivings about the legitimacy of these institutions and deplored the tendency of Congress to set up powerful policymaking bodies outside the established executive departments. Characterizing these agencies as an irresponsible "headless 'fourth branch' of the Government," the Brownlow Committee recommended that their functions be redistributed to normal regulatory agencies "set up, not in a governmental vacuum outside the executive departments, but within a department."[28]

One of the strongest arguments in support of independent commissions was their alleged capacity to attract high-caliber experts to handle the tasks of regulation. In his classic study of the commissions, however, Marver Bernstein attacked this way of thinking as basically misguided. In Bernstein's view, the training and experience of experts were more likely to predispose them to myopia and bureaucratic inflexibility than to serving a broad conception of the public interest. Expertness, he suggested, would be of significant value to regulators only when all of the following conditions were met:

> (a) the scope of the problem is narrow; (b) the task of collecting data and analyzing facts is difficult and complex; (c) discretion is severely

> limited; (d) the task involves the application of settled policy to regulatory situations and does not concern the formulation of basic regulatory policy; and (e) Congress has defined the public interest with sufficient clarity to guide the direction and content of public policy.[29]

Bernstein argued that these preconditions were rarely found in the work environments of most regulatory commissions. As will be seen, except for the growing difficulty of "collecting data and analyzing facts," the situation is not fundamentally different in most programs of contemporary social regulation. Ironically, as well, the increased complexity of fact-finding appears, if anything, to have diminished the authority of experts in policymaking.

The harnessing of scientific knowledge to military ends in both world wars, culminating in the nuclear bomb and the threat of global destruction, prompted darker concerns about fostering too close a fellowship among science, technology, and government. President Eisenhower's farewell warning against letting public policy "become the captive of a scientific-technological elite" was directed primarily against the military,[30] but it has resonated with later generations worried about the power of big corporations and the use of scientific expertise as a screen for activities that threaten public health, human dignity, and the natural environment.

The prospect of relinquishing any significant share of political authority to experts also goes against the grain in a society where the Jeffersonian ideal of democracy still finds ready public support. When policymakers who are not scientists ruefully refer to the cult of "doctor worship,"[31] they are merely voicing the popular conviction that decisions cannot be wholly legitimate if they are comprehensible only to the initiated. These are precisely the considerations that led to the wholesale opening up of the American administrative process to public scrutiny and participation in the early 1970s. David Bazelon, former Chief Judge of the Court of Appeals for the District of Columbia Circuit and an ardent defender of open decisionmaking, spoke for many when he argued that public supervision, not the myth of "disinterested expertise," was the key to responsible policies about technological risk.[32]

But skepticism about science and scientists seems capable of coexisting peacefully, if somewhat uneasily, with continued public confidence in policy development by experts. Derek Price, the historian who popularized the concept of "big science," was not out of tune with contemporary opinion when he wrote in 1963 that "the

increased status of scientists and scientific work makes them increasingly vital to the state and places the state increasingly in the position of putting technical decisions in technical hands."[33]

As if bearing out Price's optimism about experts, Jon Miller's work on public attitudes toward science policy provides suggestive evidence that the majority of citizens would rather entrust technical decisions to specialized committees than to any other form of institutional authority. Miller reports on a 1979 survey that asked respondents to identify the groups or individuals they considered most qualified to resolve issues in three policy areas: space exploration, nuclear power, food additive regulation. In all three, "scientists and engineers who specialize in this area" were most frequently designated as the preferred decisionmakers by both the "attentive" and the "nonattentive" public. In contrast, the second most preferred decisionmaker varied by issue area (federal regulatory agency for food additives; citizen referendum for nuclear power).[34]

The Contingency of Knowledge

The idealized picture of science from which the advisory process has traditionally drawn its authority has come under attack not only from political scientists and policy analysts but from a thriving area of scholarship that has abandoned the notion of science as a representation of objective reality in favor of a closer inquiry into the social processes by which scientific knowledge is produced or "constructed." Central to this body of work is the attempt to understand what makes scientists accept some claims as better than others, given that confirmation is not to be had through simple appeal to the external world. Ethnographic studies of laboratories, historical accounts of the rise and demise of particular scientific theories, and investigations of public controversies involving science and technology have all provided fruitful insights into the processes by which an image of reality gains acceptance as the real thing. This body of work suggests that science, far from being part of the solution, may in fact be part of the problem that confronts the makers of science policy.

While this book is not the place for an extended discursus on the sociology of science, three major findings from this field must be taken into account in any serious discussion of scientific advising. The first is the observation that scientific "facts" are, for the most part, socially constructed.[35] We regard a particular factual claim as true not because

it accurately reflects what is out there in nature, but because it has been certified as true by those who are considered competent to pass upon the truth and falsity of that kind of claim. Social construction begins in the laboratory, where most scientific claims originate,[36] but may reach out to include wider communities, including the news media and the lay public. Particularly relevant to the task of advisory committees are studies that show how claims related to technological risk are socially constructed and how players with different stakes in technical controversies arrive at different constructions of scientific reality.[37]

If scientific claims are constructed, then it follows that they can equally be *deconstructed,* thereby losing their factual status through reidentification of their social origins. In the formulation used by Bruno Latour and Steve Woolgar, it should be possible under appropriate circumstances to melt "reality" back into its constituent statements, "the conditions of production of which are once again made explicit."[38] Studies of the U.S. regulatory process suggest that it provides a particularly fertile environment for deconstruction, since major stakeholders have an interest in tearing down one another's version of constructed reality.[39] A primary concern of this book is to investigate how scientific advice affects both the construction and the deconstruction of claims in the regulatory process.

A second and related way in which sociology of science impinges on the subject matter of this book is by challenging the notion that scientific facts are tested and established with reference to objective criteria of validity. Thomas Kuhn's classic account of scientific change took an important step in this direction by positing that accepted scientific activity in any period is merely that which conforms to the prevailing paradigm.[40] It is the paradigm, rather than any feature of the natural world, that defines what problems are worth solving and shapes scientists' expectations of what they are likely to see when they investigate nature.

Among the sociological studies that have elaborated upon the implications of Kuhn's original analysis, Harry Collins's work on replication is particularly relevant to problems that face advisory committees. Collins identified a phenomenon that he called "experimenters' regress."[41] This is the circularity that sets in when there is no universally accepted "objective" criterion for determining whether an experiment has been competently performed. In such situations, debates about the quality of the experiment cannot be separated from

debates about its output; belief in the former requires belief in the latter, although the reality of the result ostensibly cannot be established without the properly conducted experiment. When an objective or "scientific" test of experimental quality is unavailable, Collins's data suggest that scientists freely turn to nonscientific criteria of excellence, such as faith in the experimenter's honesty, the size and prestige of the laboratory, and even personal qualities like nationality or professional group affiliations.[42] A theme that will be developed throughout this book is that the embedding of science in political frameworks exacerbates these tendencies toward personalizing issues of experimental quality.

If the most important project of sociology of science in recent years has been to expose the contingent and relativistic character of knowledge, a second and scarcely less important project has been to illuminate how science nonetheless succeeds in acquiring and maintaining cognitive authority in a distrustful world. Research on the latter project provides the third significant point of contact between sociology of science and the concerns of this book, for it suggests how scientific advisory committees are able to preserve the appearance of authority even in the face of uncertainty and political conflict.

One of the most frequent strategies used by scientists to enhance their authority is what the sociologist Thomas Gieryn has referred to as "boundary work."[43] Whether they are engaged in building professional communities, defining and excluding nonmembers, competing for resources, or asserting their autonomy against external controls, scientists use a variety of boundary-defining strategies to establish who is in and who is out of relevant peer groups and networks of prestige or authority. The most consequential—and exclusionary—of all possible boundaries is that between "science" and other systems of cognitive authority, such as religion or law. When an area of intellectual activity is tagged with the label "science," people who are not scientists are *de facto* barred from having any say about its substance; correspondingly, to label something "not science" is to denude it of cognitive authority. As we shall see throughout this book, this feature of boundary work assumes tremendous importance in debates over regulatory science, which almost by definition straddles the dividing line between science and policy. Participants in the regulatory process often try to gain control of key issues by changing their characterization from science to policy or from policy to science.

The Reform Debate

The complexity and subtlety revealed by the accumulating literature on science policy and sociology of science have exerted surprisingly little impact on proposals for improving the quality of science-based regulation. Two rather simplistic conceptions of the place of science in public decisionmaking continue to dominate the policy literature, entailing diametrically opposite prescriptions concerning the role of advisory committees.

According to one viewpoint, the technical incompetence of the bureaucracy is the most significant barrier to making the "right" decisions at the frontiers of scientific knowledge. Regulators are seen as insufficiently expert at distinguishing "good" from "bad" science and as insensitive to the standards by which the scientific community evaluates evidence. Adherents of the bureaucratic incompetence school recognize, but deplore, the amount of discretion agencies enjoy in evaluating science. Such broad delegations, in their view, simply offer decisionmakers a carte blanche to disregard information incompatible with their political goals and to formulate science policy decisions that cannot pass muster with qualified scientists.

A very different view of the problem prevails among traditionally proregulation interests—the environmental, labor, and consumer movements. Their allegations that administrative agencies misuse science usually rest on a perception that regulators are not sensitive enough to the legislative policies and social values that should guide the evaluation of complex and uncertain data. Seen from this perspective, bias in scientific assessments is most often the result either of conscious deception by industrial experts or of an uncritical acceptance of industry's viewpoint by agency officials. In either case, the problem can be seen in terms of the classic "capture" paradigm: an agency grown too close to those it seeks to regulate tends to accept unquestioningly the self-serving view of risk advanced by the regulated interests and their hired experts.

These disparate analyses of the causes of failure in science policy are associated with equally divergent philosophies about the desirable directions for reform. The "technocratic" view consistently favored by commercial and industrial interests holds that the solution is to get more and better science into decisions.[44] The recommended way of achieving this end is to expand the role of the expert community in

decisionmaking. Proposals for accomplishing this objective include the separation of scientific and political decision-making, in part by conferring more authority on scientific advisory bodies. One refrain heard with increasing frequency in recent years is that agencies should ensure that their decisions are peer-reviewed in accordance with the normal practices of the scientific community. Other proposals include removing certain types of decisions (for example, the development of risk-assessment guidelines) from the control of the agencies altogether and delegating them to such scientifically irreproachable institutions as committees of the National Academy of Sciences.

The "democratic" critique of science policy, by contrast, holds that the primary problem is the failure of the regulatory agencies to incorporate a full enough range of values into their decisionmaking. Representatives of this point of view generally ask for mechanisms that will broaden the participatory base of agency action. If technical advisory committees must be used, advocates of populist reform urge that the membership of such bodies be diversified to include more than narrowly technical viewpoints. Such critics also emphasize the need for nonscientific modes of accountability: open decisionmaking procedures, advance publication of decisionmaking guidelines, and judicial review.

In short, the positions adopted by the major interest groups with a stake in regulation approximate the two idealistic formulas that Don Price outlined for bridging "the spectrum from truth to power."[45] Today's technocratic critics of regulation eagerly accept the notion that the scientific community should organize itself so as to play a more active part in the formulation of social policy. Indeed, the technocratic critique of science policy consistently identifies insufficient consultation with the scientific community as a principal cause of regulatory failure. The democratic alternative of broader interest representation, in contrast, rests on the presumption that the average citizen can be sufficiently educated on technical issues to play an informed role in the policy process.

I have suggested in this chapter that neither the technocratic nor the democratic model accurately captures what is at stake in decisions that are at once scientific and political. The notion that the scientific component of decisionmaking can be separated from the political and entrusted to independent experts has effectively been dismantled by recent contributions to the political and social studies of science. With

the accumulation of evidence that "truth" in science is inseparable from power, the idea that scientists can speak truth to power in a value-free manner has emerged as a myth without correlates in reality. At the same time, as the following chapters will demonstrate, it has become clear that broad citizen participation alone cannot legitimate decisions that do not command the respect of the scientific community.

In order to prove genuinely useful, proposals to improve the use of science in the regulatory process have to be informed by an accurate knowledge of the internal dynamics of both science and regulation. The regulatory ideology of the early 1970s was marked by a sometimes naive faith in the power of American institutions to identify and control technological insults to public health and the environment. Subsequent years have seen a retreat by Congress, the courts, and the agencies themselves from an excess of optimism. There is a recognition that the economy is not infinitely robust, that knowledge is imperfect, and that some risks may have to be tolerated in order to encourage innovation and secure the progressive benefits of technology. Numerous new approaches to regulation—the "bubble" policy, the use of offsets, *de minimis* risk analysis, right-to-know policies—testify to a more cautious, pragmatic, and incremental definition of objectives than was prevalent a decade ago. A similar caution has to mark any attempt to improve the framework of scientific advice-giving. However rhetorically appealing it may be, no simple formula for injecting expert opinion into public policy holds much promise of success.

An Alternative Approach

In examining the interaction between expert committees and agencies, I attempt to break away from the largely ahistorical and case-oriented literature on science policy. Although the chapters on scientific advisory mechanisms contain material on current policy controversies, I make an effort to root them in a deeper historical setting. Individual regulatory proceedings are presented as stories with a temporal dimension corresponding to changes in national politics and scientific knowledge. Finally, as this opening chapter indicates, my chosen approach is interdisciplinary. It seeks to incorporate insights not only from the "expected" fields of law, political science, and pol-

icy analysis, but also from areas of scholarship that are more particularly concerned with understanding the nature of scientific knowledge and its relation to political power.

In line with these objectives, the first four chapters of the book criticize and set aside the two prevailing models by which science is legitimated in regulatory policymaking. In particular, Chapter 2 gives an account of four controversies that helped sharpen public awareness of problems in the field of science policy and revealed serious institutional deficiencies in the production and use of regulatory science. The chapter reviews the reform proposals that grew out of these four incidents and argues that the controversies in fact carried a more ambiguous message than is evident from these proposals. Chapters 3 and 4 describe, respectively, the shortcomings of the democratic and technocratic models of incorporating science into policy. Chapter 3 analyzes the primary nontechnocratic methods of securing accountability in science policy decisions: judicial review and open decisionmaking. The limitations of these techniques underscore the continuing need for scientific advisory mechanisms in the regulatory process. Chapter 4 contrasts the science used in policymaking ("regulatory" or "mandated" science) with "research" science and uses the analytical literature on science fraud to argue that many of the problems of accountability identified in the former are actually encountered, albeit in more attenuated form, within the latter.

Chapters 5 to 9 present empirical data about the way advisory bodies are used by two of the most intensive consumers of science among the federal agencies: EPA and FDA. Specifically, Chapter 5 describes the role of EPA's agency-wide Science Advisory Board, while Chapters 6 and 7, respectively, look at two committees attached to self-contained regulatory programs under the Clean Air Act and the Federal Insecticide, Fungicide, and Rodenticide Act. Chapter 8 assesses a variety of advisory committee structures used by FDA in its decisionmaking on pharmaceutical drugs and food additives. The objective of Chapter 9 is to illustrate how expert advisory systems function when scientific decisionmaking has to accommodate changes in both politics and knowledge. The two cases analyzed in this chapter are the development of guidelines for cancer risk assessment and the regulation of formaldehyde.

In Chapter 10, the focus shifts to mechanisms other than advisory committees that have succeeded, to varying degrees, in shifting regulatory decisionmaking toward the technocratic model. The chapter also

evaluates the prospects for generalizing these approaches to other areas of policymaking. Finally, Chapter 11 presents a revised and enriched picture of the way science interacts with politics in the regulatory process and indicates how the provision of scientific and technical advice to regulatory agencies can be improved and made more effective.