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An Uneasy Balance: Science Advising and the Politicization of Science

Science and technology-related issues are pervasive in today's society. Science contributes in many ways to our lives, whether directly in health-related matters or more indirectly through effects on the environment, economic development, and international relationships. What is science and technology policy? While difficult to define, one author described it as "a governmental course of action intended to support, apply, or regulate scientific knowledge or technological innovation" ([1], 12). As we will explore, policy sometimes takes the form of governmental action, but occasionally inaction results because of political considerations. Nongovernmental actors also affect public policies, including nonprofit advocacy organizations, educational institutions, and businesses. Policies may be divided into two types: decisions affecting the funding or direction of science ("policy for science"), and decisions that draw on scientific data to inform policy debate ("science in policy") [2]. Issues regarding the funding and direction of science are obvious examples of science and technology policy, but we will demonstrate that the latter (science in policy) are as important for the population at large.

How are policy decisions made? An abstract description includes five stages: the perception and definition of a problem by the public and policymakers, the formulation of possible solutions by policymakers, the adoption of a policy, its implementation, and then an evaluation of the outcome of the decision [1]. It is rare that the political policymaking process follows this tidy description—a field of social science, policy science, attempts to develop a rational framework for understanding, predicting, and directing the policymaking process [3].

Several features of science policy issues distinguish them from more general policy questions [1]. Particularly in the life sciences, the pace of technological change is rapid, and issues arising from new developments are novel. The technologies are complex, and difficult for both policymakers and the general public to grasp. New developments may carry irreversible consequences, and once in use, it may be difficult to stop their application. New technologies may raise strong public worries about threats to health and safety, the environment, or other areas of concern. Finally, many developments challenge deeply held social, moral, and religious values. All these factors may contribute to the difficulty in establishing effective policy. As will be demonstrated by the case studies presented in the upcoming chapters, how a question is formulated—by whom, and under what time and political constraints—can have an enormous impact on the decisions that are made.

Although scientific input is only one factor in policymaking, having accurate, timely, and accessible information is valuable for developing appropriate responses. Policy is made by all branches of the federal government—executive (including regulatory agencies), legislative, and judiciary—and state governments. Foreign governments also make policy, and treaties are often used to secure consistent international policies on far-reaching issues, such as in the domains of the environment (e.g., global warming and biodiversity), trade, and human rights. Given the range of policy challenges facing governments, how does scientific understanding and knowledge contribute to the decision-making process? This chapter provides an overview of the ways in which scientific information may be used by the federal government to develop policy. It then goes on to discuss the inherent conflict between science and politics, and how this leads to the apparent politicization of science.

Science Policy and Government

In the United States, science may contribute to policy discussions on several levels. There are close to a thousand advisory committees in the federal government; about half of these deal directly or indirectly with scientific or technological matters [4, 5]. Scientists may advise the president and other members of the executive branch on establishing directions for research and setting the agenda for future development through cabinet-level positions. Scientists offer testimony to Congress, adding their expertise and opinions to the debate. They also contribute to the development of regulations by the numerous regulatory agencies given responsibility for the oversight of different science-related activities. The courts influence policy by an array of decisions; some rule directly on matters regarding science (patents, etc.), and some reverse policy decisions made by other branches of government. Judicial rulings informed by "expert testimony" may alter existing policies or drive the development of new ones. The courts might also determine that a new law or regulation violates the Constitution or statutes, requiring reevaluation by the body creating or instituting the policy. The government may request that studies be conducted by independent nonpartisan organizations such as the National Academy of Sciences (NAS) to provide information to aid the policy process.

In a democratic society, policy decisions are rarely made without some consideration of public opinion—unpopular decisions might be rebuked at the ballot box. As citizens, scientists may seek to influence politicians to support their views. Scientists and their employer institutions (corporate or academic) and professional societies may actively lobby for specific policy decisions; one major focus of such lobbying is research funding. Scientists may also work as advisers to organizations that take activist roles in influencing public opinion and driving policy decisions. Individuals with scientific experience or interests may work as journalists to help inform the public on new issues. At the same time, the public's understanding, or lack thereof, of new scientific developments may lead to calls for governmental action. If not tempered by sound advising, poorly conceived or nonsensical policies may result.

Science in the Executive Branch

The president appoints individuals to a number of senior-level advisory positions in science and technology; these advisers wield significant power in determining the influence of science in government [6]. Since World War II, the highest ranking of these is the assistant to the president for science and technology (APST); the same individual usually (but not always) serves as the director of the Office of Science and Technology Policy (OSTP), an advisory group created in 1976 by an act of Congress. The president is not required to name such an assistant; President George W. Bush's senior science adviser, John Marburger, was named head of the OSTP only [7]. The National Science and Technology Council was established in 1993 by an executive order, and includes the president, vice president, APST (if there is one), cabinet secretaries, and agency heads with significant science and technology responsibilities [8]. The council's main objective is setting clear national goals for investments in science and technology. Other high-level advisory groups are the President's Council on Science and Technology, which examines a broad range of topics, and the President's Council on Bioethics, which provides input on ethical issues arising from developments in the life sciences. Most cabinet departments include directors with direct responsibility for science and technology policy; among these are the departments of agriculture, commerce, defense, energy, health and human services, interior, and labor. Other independent agencies with directors or administrators named by the president include the National Science Foundation (NSF) and the Environmental Protection Agency (EPA) [4].

Senior-level advisers must have the president's ear if they are to contribute to the policymaking process. Advisers who have only limited access to the president or key deputies will have little impact. The effectiveness of science advising in the White House is tied to the president's interest in scientific issues. In addition, senior-level appointments generally reflect the ideology of the president; these individuals serve to translate the president's viewpoints into policy directions for the agencies that fall under the aegis of the directors [1]. It is therefore not surprising that regulatory agencies appear to make U-turns in overarching policy with each change in administration.

An increasing concern is the growing delay in the appointment of individuals to these important advisory positions [4, 9, 10]. Two factors contribute to the problem: the growing number of presidential appointments overall (with over five hundred senior-level positions alone), and the requirement that many nominees must be confirmed by the Senate. Identifying qualified candidates who are interested in taking a government position may be difficult, particularly in view of the amount of paperwork involved in the review process, the heavy workload, and the comparatively low salaries. Candidates must undergo rigorous background checks that may take months. Finally, Senate confirmation hearings may be delayed if an influential member disapproves of a candidate. As a result, the amount of time for a nominee to be approved has increased from just over two months during the Kennedy administration nearly nine months during the first term of President George W. Bush [4]. In addition, as of January 2002, halfway through President Bush's first term, there were close to one hundred positions for which candidates had not even been named [9].

Delays in filling senior-level appointments may have a chilling effect on policy development, leaving agencies without strong leaders to direct policy. Delaying appointments may be used deliberately to slow the development of new regulations, as was done by President Reagan as part of his generally antiregulatory stance [9].

Federal Advisory Committees

Federal advisory committees play important roles in shaping public policy. There are hundreds of advisory committees focusing on science and technology issues; some advise regulatory agencies, and others serve to advise the president or Congress. Committees may be created specifically to address controversial issues for which the government feels it needs expert advice. In 1972, concerned at the ever-growing number of committees, Congress enacted the Federal Advisory Committee Act (FACA, 5 U.S.C. App.), aimed at limiting the creation of new committees, and establishing standards for committee membership and operations. FACA also mandated "transparency" in committee deliberations; membership on most committees is published, and at least some meetings are open to the public. Central to the law's mission is a mandate that membership on the committees should be balanced, and viewpoints should be represented by accomplished individuals in the policy area. For science and technology, committee members should be chosen for their expertise in the relevant scientific area and their respect within the professional community [4]. Creating effective and unbiased committees is a major challenge, and will be discussed further below.

Federal Agencies

Federal agencies—part of the executive branch, but often referred to as the fourth branch of the federal government because of their unique powers—are the operational arm for many executive and congressional science policy mandates; they create functional policy in response to law. Science oversight is highly fragmented within many agencies and departments. Among those most involved with the biological sciences are the Department of Health and Human Services (DHHS), which includes the Food and Drug Administration (FDA), the Centers for Disease Control and Prevention (CDC), and the National Institutes of Health (NIH); the NSF; the Department of Agriculture; and the EPA. Almost all other departments also contribute to issues in the biological sciences, including the Department of Defense (for example, on bioterrorism policy), the Department of the Interior (the Fish and Wildlife Service), the Department of Labor (the Occupational Safety and Health Administration), and the Consumer Products Safety Commission.

When Congress passes a law, it is the responsibility of agencies to develop regulations that define and enforce the legislation's mandates. Developing regulatory policy again requires the input of science: What is practical? What limits should be set? For example, if a statute mandates that new drugs must be safe and effective, it is the FDA's responsibility to develop and enforce regulations to achieve that goal. Public or congressional objections to new regulations may impel the agency to revise the regulation.

Although many agencies, such as the NIH and the FDA, have quasi-independent status, this freedom is tempered by the strong role that the president plays in determining overall policy direction through senior-level appointments. Congress may also act to limit agencies' ability to enact or enforce policy by controlling appropriations; actions unpopular with Congress may lead to reductions in operating funds or substantive changes in the agency's enabling legislation.

Science and Congress

Congress exerts enormous influence on the direction of science through the appropriations process. The scientific community has a major stake in the congressional determination of levels of research funding, sometimes termed policy for science. Although the purse is arguably the biggest tool wielded by the federal government, other kinds of policy decisions regarding innovation, intellectual property, and trade also fall under this rubric. Intense lobbying by scientists and scientific organizations for funding in specific areas is common. Critics suggest that such lobbying is self-serving; the goal is to gain research funds for one's own projects rather than make choices in the best interests of the nation [11]. Scientists counter that the products of research may not be predicted and broad general support is needed. Congress also provides funding for federal agencies by passing budgetary bills. Both the president, who proposes a budget, and Congress have considerable impact on agency activities, from conducting research to enforcing regulations, through their control of funding.

Science also widely informs policymaking by Congress. Since few politicians have scientific training, they may turn to congressional staffers or outside experts to provide guidance [1, 7, 12]. Congressional committees hold hearings on selected topics, and the invited scientists may offer testimony relating to issues of science and technology. Congressional hearings may also serve to put regulatory agencies on notice that a response is needed—or Congress may act. Congress, however, may pass laws that cannot be implemented by the relevant regulatory agency for either practical or political reasons; carrying out the mandate may be too expensive, too complex, too unpopular, or simply impractical. Congress has even prohibited agencies from spending money on specific regulatory activities.

Congress may turn to government support agencies for a thorough study of the issues. The General Accounting Office (renamed the Government Accountability Office in 2004, or the GAO), established in 1921, frequently provides reports on the possible effects or results of legislation or regulations. It may explore the economic costs of action or the effectiveness of certain approaches to a problem, and then makes recommendations for change or improvement. From 1972 until its closure in 1995, the Office of Technology Assessment (OTA) provided hundreds of comprehensive reports to Congress on a wide range of scientific and technological issues [13, 14, 15]. These reports, intended for congressional committees, served a much wider community. The OTA, however, was criticized for its slow response to requests for information. The new Republican-dominated Congress in 1995 closed the OTA purportedly for primarily budgetary reasons. Yet, a perceived "liberal" bias in its reports contributed to its demise [15]. Without the OTA, Congress now turns more to an independent organization, the NAS, for advice (see below).

Science and the Courts

The judiciary branch of government plays an active role in science policy. Far from being purely reactive, often the courts step in to resolve controversies for which policy has yet to be developed [2]. Court decisions may interpret the impacts of science and technology, generate "authority" for scientific knowledge, and place limits on certain scientific activities. Judicial review of federal agencies is mandated by the Administrative Procedure Act of 1946 and later legislation, which authorizes the courts to invalidate decisions if they are not based on sound evidence [2]. Nevertheless, judicial decisions also can produce an incoherent set of policies when conflicts are resolved on a case-by-case basis, and bring up fundamental questions about the competence of courts to make social policy in light of the practical constraints on fact finding and jurisdiction raised by cases and controversies presented to the courts [16]. Many of the case studies described in the upcoming chapters are influenced by judicial decisions.

Outside Advisory Groups

The federal government may seek advice from outside groups in shaping science policy. Depending on their membership, outside advisory groups may provide independent nonpartisan or highly skewed advice. The National Research Council (NRC) is the operational arm of the NAS, the National Academy of Engineering (NAE), and the Institute of Medicine (IOM). President Abraham Lincoln asked Congress to establish the NAS in 1863 as an independent organization to provide scientific advice to the government; membership was offered to the leading scientists of the day. In 1916, the NRC was founded to carry out the research and advisement activities of the NAS, leaving the NAS and its affiliates as largely honorary societies. Membership in the NAS is highly prestigious. There are around eighteen hundred living members; an additional thirty-one hundred individuals are members of the NAE and IOM [17].

Each year, select committees formed at the NRC research topics requested by Congress, federal agencies, or other groups. The NRC has an internal system of assuring broad representation on committees, and members must reveal any potential bias or conflict of interest. The final reports, like those of the OTA, are widely read and cited. Yet the NRC is also criticized for the slow appearance of reports [18, 19]. Because the NRC is comparatively independent of political pressure, it may produce reports that run contrary to what the agency requesting the study anticipated. The NRC's recommendations are not binding, so the government or other critics may choose to ignore the study's conclusions or seek to discredit them.

Other "think tank" organizations that may conduct research under contract with the government include the more politically liberal Brookings Institution, the politically conservative Heritage Foundation, and the libertarian Cato Institute as well as more neutral policy research institutes such as the RAND and MITRE Corporations. Such consultants—of which there are many—are generally referred to as "Beltway bandits" for their proximity to the main highway that loops around Washington, DC. The federal government may also assemble its own study groups to explore issues; these panels are often criticized as reflecting the bias of the administration.

The Politicization of Science: Conflicting Goals of Science and Politics

Whatever the means of input, there is a constant tension between science and politics. From the perspective of science, policies should reflect careful consideration of the scientific data, and should be in line with the findings and recommendations of science. Scientists who offer advice to policymakers, however, often complain that their input is ignored or distorted during the policymaking process. Political values and necessities may conflict sharply with the data presented by scientists. A policy may be developed that represents a compromise between the criteria determined by science and the pragmatic needs of politics. An effective policy should be cost-effective and fair, place limited demands on government, and provide assurance to the public that the goals will be met [20]. If an administration's position is not supported by the data, it may ask for further studies rather than accept what is offered. In extreme cases, scientific data might be buried in the face of the apparent demands of politics.

The selective use of scientific advice and information has received heavy media coverage in recent years. This strategy is not new, though, President Richard Nixon removed all science advising from the White House during his tenure because he objected to reports with recommendations against his own projects; he also expressed strong irritation toward the apparent left-leaning political viewpoints of many leading scientists [1, 21]. Examples of policies that either ignored or ran contrary to scientific input are common in the physical sciences—for instance, the cancellation of the Superconducting Supercollider for budgetary reasons in the 1980s despite strong support from physicists.

Science advice is subject to harsh criticism from both the left and right wings of the political spectrum. Advocates for more regulation might argue that scientific evidence is distorted in order to avoid establishing regulations, while those opposed to regulation contend that science is distorted in order to promulgate intrusive and inappropriate regulation [1, 6, 22]. Critics label advisers as incompetent or biased, committees as unbalanced or unduly influenced by certain positions, and supporting science as flawed and incomplete. Because scientific information is rarely clear-cut, science policy recommendations remain vulnerable to criticism. In addition, critics may seize on reports of scientific misconduct as justification for discounting all work in a controversial area [15]. Finally, because many leading scientists are also recipients of federal funding, critics charge that their advice is tainted by the desire to obtain more research funding.

The level of concern over suppression of scientific information and manipulation of committees reached new heights during the presidency of George W. Bush [23]. For example, shortly after taking office in 2001, the Bush administration rescinded the new limits on arsenic levels in drinking water introduced late in the Clinton administration; arsenic is known to cause cancer. The mining industry strongly opposed and lobbied against the new regulations. Christine Todd Whitman, the new EPA director, argued that the scientific data supporting the lowered limits were uncertain [24, 25]. After a storm of protest from both environmental groups and members of Congress, the EPA asked the NRC, which had issued a comprehensive report in 1999, to review the scientific evidence on the effects of arsenic again. The NRC report, released in September 2001, found that even its previous recommended standards were probably too high [26]. In November 2001, the EPA agreed to adopt the standards proposed by the Clinton administration starting in 2006 [27]. The Bush administration's proindustry position on environmental and health issues continues to draw criticism from advocates of strong regulation.

Beginning in 2003, a growing chorus of critics maintained that the Bush administration sought to suppress science and stack membership on advisory committees by selecting only those representatives who express the administration's preferred viewpoints [5, 28, 29, 30, 31]. Critics argued that biasing scientific analysis inherently subverts the advisory committee process [21]. One example was the failure to reappoint two members of the President's Council on Bioethics who expressed strong support for human cloning and stem cell research during their first term on the committee, contrary to the more limited support expressed by the administration and the council's chair [32]. Marburger, the OSTP head, responded that such attacks were a significant distortion of the administration's actions and a reflection of partisan politics leading up to the national election of 2004 [33]. He also reminded the critics that science is but one input into the policy process.

A second criticism leveled at the Bush administration is that it subjects candidates for committees to questions regarding their political views and affiliations that are inappropriate given the FACA guidelines and other legislation [30, 34]. The administration even asked potential committee members if they had voted for the president. A GAO report in April 2004 recommended that additional guidelines be developed to assure that advisory committees are both independent and balanced [35]. A follow-up response by the GAO, requested by Congress, indicated that while existing law prohibits discrimination in federal hiring based on political affiliation, the applicability of such antidiscrimination regulations to federal advisory committees must be determined on a case-by-case basis [36]. Thus, although the scientific community and other critics may find such political litmus tests distasteful, they are not necessarily illegal. Nevertheless, creating committees whose scientists do not represent the range of expertise relevant to the difficult issues under discussion does not appear to achieve the goals of the advisory process. Some members of Congress, however, argue that many "scientific" issues have, at their heart, nonscientific controversies. Asking about political affiliations and positions is therefore appropriate in order to best represent differing points of view [37]. In February 2005, Representative Henry A. Waxman (D-CA) introduced the Restore Scientific Integrity to Federal Research and Policymaking Act (HR 839) to block political litmus tests and other interference for federal scientists. In October 2005, Senator Richard Durbin (D-IL) attached a similar amendment to the appropriations legislation for the DHHS, the Department of Education, and the Department of Labor. President Bush signed the appropriations bill into law on December 30, 2005 [38].

Given the heightened partisan rhetoric over science advising in recent years, is it possible to find a balance? A number of suggestions have been made: reestablish the OTA to improve the quality of scientific advice to Congress and reduce the dominance of advising in the executive branch, regularize science policy in the executive branch, and involve the public more in deliberations so that citizens feel more invested in the decisions [7, 15, 39]. To imagine that scientific advising will ever be free of politics is both naive and self-defeating. The challenge remains to find ways to insulate scientific advising from political ideology so that differing interpretations of scientific data are represented and considered when making new policy.

While most people would agree that advances in scientific knowledge, particularly in biomedical areas, have improved their lives, scientific discoveries may also give rise to contentious and sometimes alarming developments. Science is not seen as a universal good. Particularly in recent decades, many now view both scientists and science with suspicion and distrust. Nevertheless, both government and the public must find ways to make decisions on applications of new knowledge.

Case Studies in Science Policy

Eleven chapters of this book use case studies to explore mechanisms of scientific input into policy decisions and examine the issues raised here. Each chapter includes background information on the biology underlying the issue as well as an exploration of policy.

Chapter 2 explores policy for science using the Human Genome Project (HGP) to discuss the federal funding of research. It compares the "big science" of the HGP to more typical investigator-initiated research projects, and looks at the potential impact of big projects on the focus and direction of research in biomedical areas. Two short sections explore peer review and the alternative approach to funding using congressional earmarking, and congressional influence on the direction of science.

Chapter 3 examines aspects of information sharing, and the conflict between the public and private support of research, through the history and impact of gene patenting. The effects of patenting on access to information are discussed. The broader impact of patenting the genome is also explored. Two sections examine cases in which human tissues and DNA were exploited by researchers, raising questions about fairness and commercialization in biotechnology.

Chapter 4 explores issues of self-regulation by the scientific community using assisted reproductive technologies as a case study—asking, When should government step in to control the directions of research and clinical medicine? The development of regulation in the United Kingdom is compared with the absence of oversight in the United States. The two sections in this chapter discuss the recent push to ban human cloning and its potential impact on stem cell research, and the early history of recombinant DNA research as an exemplar of self-regulation.

Chapter 5 uses the development of new drugs to treat AIDS to introduce the role of federal agencies in regulating science. The conflict between public demand, the interests of industry, and safety concerns is explored. The two sections provide a perspective on how regulations protecting human and animal subjects were developed. The appropriateness of certain kinds of human experimentation is discussed.

Chapter 6 addresses the role of scientific input into court cases, and the contrast between scientific evidence and public perception. Silicon breast implants are used to illustrate how misperception about the risks led to huge settlements in the absence of any scientific evidence showing that the implants caused the medical problems. The sections here describe the current guidelines for scientific evidence in the courts, and also touch on continuing controversy concerning the use of DNA testing in forensics.

Chapter 7 explores the role of the media in influencing public opinion about science using coverage of new treatments in the "war" on cancer. Coverage can have impact on public perceptions, decisions by policymakers, and the stock value of companies conducting research. Media coverage can mislead the public and artificially raise hopes. The responsibility of journalists in informing the public is discussed in a section about the risks of electromagnetic fields (power lines and cell phones).

Chapter 8 looks at the complex relationship between free enterprise and scientific responsibility. The tobacco industry is used as a case study to explore why government may be reluctant to regulate, even in the face of clear evidence that a product is unhealthy. The concealment of evidence from the public is also discussed. Two sections address conflicts of interest and scientific misconduct.

Chapter 9 examines the emerging area of bioterrorism, provides a brief history of biological weapons, and discusses the 2001 attack involving anthrax-laden letters. The government public health response is scrutinized in the broad context of civil liberties. The two sections here use the recent SARS epidemic to assess public health responses, and explore moves to censor science and classify some forms of research.

Chapter 10 examines international policy issues involving science, and looks at the differing responses to genetically modified organisms in the United States and abroad, exploring how public opinion can impact policymaking internationally. A section examines the international impacts of mad cow disease.

Chapter 11 explores the complexities of environmental policymaking using air pollution as its case study. The challenges of competing interests are discussed and the difficulties of developing rational policy are outlined. One section examines lead poisoning and the challenges of generating effective policy even when the risks are known. A second section offers insights into risk assessment and how it is used in policymaking.

Chapter 12 examines situations in which scientists are asked to weigh in on issues that do not have a scientific basis. The shortage of organs for transplantation places pressures on physicians to develop rational approaches to the distribution of organs. The current situation for organ transplantation in the United States is described. Proposals on how to increase the rate of donation are discussed. Two sections address the possibility of using animal organs for transplant along with end-of-life issues.

Chapter 13 provides a synthesis of and conclusions about science policy drawn from the case studies. It presents continuing challenges and unresolved questions.

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