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IN 1976 animal rights activists picketed the American Museum of Natural History in New York City to block experiments that seemed to impose unnecessary cruelty and pain. A decade later protesters were trashing laboratories, stealing animals, and demanding on moral principles the end of all animal research. The controversy over animal research is but one of the many disputes over scientific developments and technological applications that have proliferated over the past 20 years. And like the animal rights protests, they have escalated their tactics and increased their demands. Antiabortionists succeeded in banning federal funds for research using the human fetus from 1981 to 1994. Gay rights activists have challenged the procedures and guidelines surrounding the use of HIV tests. Protesters with moral reservations have joined farmers with economic concerns to obstruct the applications of biotechnology. Religious groups have opposed the teaching of evolutionary biology in public schools. And just as environmentalists confront corporate policies that threaten global resources, so corporate interests have disputed scientific commissions that threaten to impose regulations.[1]

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These and other controversies over science and technology are struggles over meaning and morality, over the distribution of resources, and over the locus of power and control. Over the past few decades, science has increasingly become an arena to battle out deeply contested values in American society. We prize efficiency yet value political participation. We insist on individual autonomy yet expect social order. We value scientific knowledge yet fear the influence of scientific ways of thinking on widely accepted beliefs. Controversies over science and technology reveal tensions between individual autonomy and community needs. They reflect the ambivalent relationship between science and other social institutions such as the media, the regulatory system, and the courts. They highlight disagreement about the appropriate role of government, concerns about the increased role of technical expertise, and discomfort with the instrumental values so fundamental to the scientific endeavor (Ezrahi, 1990).

Controversies offer a perspective on the politics of science and a means to explore public attitudes. As disputes have proliferated so too have studies that document and analyze them. In this chapter, I draw from this growing literature to analyze the dynamics of science controversies as they have come to express political tensions as well as moral reservations about the value of certain scientific practices.

Sources of Public Ambivalence

Controversies over science and technology have often focused on the question of political control over the development and applications of science. But in the last decade protests against science have assumed an increasingly moralistic spin. Many recent disputes are framed in terms of moral absolutes. Fetal research is “wrong” and should be abandoned regardless of the clinical benefits. Animal experimentation, likewise deemed immoral, should be banned regardless of its contribution to medical knowledge. Many of the critics of science—creationists, antiabortionists, ecologists, animal rightists—are uneasy with instrumental activities that turn nature, fetuses, women, or animals into resources or tools. Their moral concerns have radicalized many of the protests that began as political challenges in the 1970s.

The development of science and technology remained largely unquestioned during the period of rapid economic growth that followed World War II. But by the 1970s belief in progress was tempered by growing awareness of risks. Technological improvements were threatening neighborhoods and causing environmental problems; drugs to stimulate the growth of beef cattle were causing cancer; efficient industrial processes were threatening worker health. Even efforts to control technology seemed to pose inequities as new standards and regulations pit economic expectations against the quality of life.[2]

Ironically, surveys indicate little change in the level of public support of technology over the past 20 years (Miller, 1990). When questioned, most people perceive science and technology as instrumental in achieving important goals and believe that the benefits of technology outweigh the risks. However, in the early 1970s, concerns about environmental problems began to generate political efforts to obstruct specific projects and to increase public participation in technology policy decisions. A decade later, even scientific research lost its exemption from political scrutiny. Antiabortionists blocked the availability of federal funds for fetal research; a rapidly expanding animal rights movement brought regulation and constraints on biomedical research practices; and challenges from whistle-blowers brought congressional investigation and oversight to the research community, threatening its long-standing autonomy from political regulation and public control.

Many scholars have addressed the significance of these trends. In March 1978 an issue of *Daedalus,* titled “The Limits of Scientific Inquiry,” examined the proposition that some kinds of research should not be done at all. The same year, a conference, “Social Assessment of Science,” examined international efforts to impose regulations on research.[3] Throughout the 1980s there was talk about the “crisis” in science as research seemed faced with attacks by forces from both the left and the right. Some regarded the activities of protest groups as a form of nineteenth-century Luddism—a wholesale rejection of science and technological change. One observer, Zbigniew Brzezinski (1970), called such opposition “the death rattle of the historically obsolete.” Another, Theodore Roszak (1968), believed that protest is a positive and necessary force in a society that “has surrendered responsibility for making morally demanding decisions, for generating ideals, for controlling public authority, for safeguarding the society against its despoilers” (p. 22).

Today's controversies reflect a long history of ambivalent public attitudes toward science in American society (Mazur, 1981). The acceptance of the authority of scientific judgment has long coexisted with mistrust and fear, revealed, for example, in the early opposition to innovations such as vaccination or to research methods such as vivisection. The romantic view of the scientist as “a modern magician,” a “miracle man who can do incredible things,” has been paralleled by the negative images of mad scientists: the Dr. Frankensteins and Dr. Strangeloves that pervade popular culture (Roszak, 1974, p. 31).

In part, public ambivalence has been a response to the obscurity and complexity of science that appears to threaten the power of the citizen. The growing importance of expertise in policy decisions seems to limit the democratic process (Goggin, 1986).[4] Activists demand greater involvement in decisions about science and technology, seeking participation in review boards and decisionmaking groups. However, only about 5% of American adults are both attentive to science policy issues and sufficiently literate scientifically to understand and assess the arguments underlying the disputes (Miller, 1990). Thus disputes often have less to do with specific technical details than with broad political issues: They represent the growing polarization between those who see scientific and technological developments as essential to social progress and those who see these developments as driven by political or economic interests (Richards, 1988); between those with programmatic agendas seeking to implement specific goals and those with moral lenses concerned about accountability, responsibility, and rights. Some controversies (e.g., over the superconducting supercollider) remain mainly at a policy level where issues are debated by experts, ethicists, and policy elites. Others (e.g., over the use of animals in research) are public protests engaging social movements and citizens groups. Sometimes concerns have less to do with the implications of science and technology than with the power relationships associated with them. Protests may be less against specific technological decisions than against the declining capacity of citizens to shape policies that affect their interests; less against science than against the use of scientific rhetoric to mask political or moral choices (Fischer, 1990).

Questions of power, responsibility, and accountability continue to drive disputes. But controversies have also changed over time. In the 1970s and early 1980s, they represented the so-called crisis of authority that prevailed in the political life of that time (Salomon, 1977a). And they indicated the willingness of local groups to mobilize against decisions that affected particular interests. By the end of the 1980s, protesters increasingly framed their attacks on science in the moral language of rights.

By 1990 Yaron Ezrahi, in *The Descent of Icarus,* suggested that the attacks against science represent a major conceptual change in the role of science in society: “In the closing decades of the 20th century, the intellectual and technical advances of science coincide with its visible decline as a force in the rhetoric of liberal democratic politics” (Ezrahi, 1990, p. 13).

A Typology of Disputes

Studies of controversies suggest their origin in a range of political, economic, and ethical concerns (Engelhardt & Caplan, 1987; Graham, 1979; National Academy of Sciences, Institute of Medicine, 1991).

First, the most intense and intractable disputes concern the social, moral, or religious implications of a scientific theory or research practice. The controversy over the teaching of evolution in public schools has persisted at the level of local school districts, even after a U.S. Supreme Court decision seemed to bring closure to the issue (Nelkin, 1984a). The practice of animal experimentation has spawned a belligerent animal rights movement morally opposed to the use of animals as tools (Jasper & Nelkin, 1992). The 1970s' opposition to fetal research was amplified with the development of new medical uses for fetal tissue (Maynard-Moody, 1992). And the creation of transgenic animals through techniques of biotechnology provoked the opposition of groups convinced that tampering with "natural" forms of life is morally suspect (Krimsky, 1991). These and other disputes reflect the preoccupation with morality in American society. Even as biomedical research brings about dramatic improvements in medical care, critics question and, indeed, try to stop certain areas of science that threaten their moral convictions. As new therapeutic possibilities emerge—such as the ability to intervene in the reproductive process or to use fetal tissue for transplantation and research—they too become the focus of moral disputes. Some defend these practices for their therapeutic benefits; other see only the potential abuse. For critics, the use of women as surrogate mothers, or the use of animals or fetuses in research, are morally questionable activities threatening concepts of personhood and violating fundamental beliefs. These critics are not simply questioning specific research practices; they are challenging the basic values underlying research.

A second type of controversy reveals the tensions between environmental values and political or economic priorities. Many disputes arise when the interests of citizens are threatened by decisions to site noxious facilities—power plants, toxic waste disposal dumps—in their neighborhoods (Brown & Mikkelski, 1990). Such ubiquitous conflicts engage communities in prolonged political actions expressing what has been called the NIMBY (not in my back yard) syndrome (Freudenburg, 1984). They raise questions about equity in the distribution of risks, the role of the citizen in technological decisions, and the access of local communities to expertise. Similar tensions over environmental values are expressed in the growing concerns about the global implications of technological decisions. The threat of ozone depletion (Brown & Lyon, 1992) or oil spills from supertanker disasters (Clarke, 1992) pose problems that can hardly be considered in a local political context. Yet local political structures and economic interests often support controversial policy choices that reflect short-term economic or political priorities. Such issues have generated a "new environmentalism" that has been refocusing controversies on the global dimensions of the environmental problems caused by technological change (McGrew, 1990).

A third type of controversy focuses on the health hazards associated with industrial and commercial practices, and the resulting clashes between economic interests and those people concerned about risk (Rosner & Markowitz, 1991). We are deluged with warnings about "invisible" hazards (PCBs, freon, radiation, the carcinogens in food additives—the list is long and ever growing). Uncertainties about the extent and the nature of risk have aggravated public fear. Gaps in technical information inevitably leave considerable leeway for conflicting interpretation. While new technologies have increased our capacity to detect potential risks, the public is confused by disputes among scientists. What food should we eat? How dangerous is the workplace? How should the possibility of risk be weighted against potential benefits? Risk disputes focus on balancing

competing priorities in decisions about regulation and the setting of safety standards, and on ways to best protect the public and those working in hazardous occupations (Nelkin, 1985).

A fourth type of controversy over technological applications reflects the tension between individual expectations and social or community goals. Characteristically, such controversies, reflecting the usual disputes over government regulation, are framed in terms of “rights,” and they frequently revolve on the introduction of science and technology. If a water supply is fluoridated, universal vaccination required, or a course of study mandated in the public school curriculum, everyone must comply with the decision and share its consequences. If the use of a pharmaceutical product like AZT is constrained, those who want it are denied. Government bans on alternative cancer therapies may infringe on a patient's right to choose her own medication (Markle & Petersen, 1980). Gun control legislation threatens the individual's freedom of choice. Governments impose constraints on individual behavior to protect the community, but constraints on individual freedom may also be interpreted as protection of professional turf or as unnecessary government paternalism.

Scientific developments are sometimes perceived as threatening to individual rights. Advances in the neurosciences, for example, may be used to impose social controls over individual behavior (Nelkin & Tancredi, 1994; Valenstein, 1980). Theories suggesting the biological basis of human behavior evoke fears that genetic determinism will be used to justify state control over reproductive rights (Hubbard & Wald, 1993). Creationists see the teaching of evolution as a threat to their right to maintain the religious faith of their children. AIDS patients see requirements for HIV testing and partner notification in the case of a positive diagnosis as a threat to their right to privacy. And scientists themselves view external controls over research as an infringement of their right to free inquiry. Many of these disputes play on tensions in American society over the appropriate role of government and regulation and the extent to which community values or, in some cases, public health requirements may intrude on the rights of individuals.

There are other types of disputes. Megascience projects such as the superconducting supercollider, the Human Genome Project, and the space program have generated conflicts over questions of equity in the distribution of resources within science (Dickson, 1984). The growing commercial interest in biotechnology products and the expansion of industry-university collaboration in this field have become a source of disputes over patenting and property; those advancing technological innovation in a competitive market conflict with those who believe the public interest would be better served by more open communication of new ideas (Krimsky, 1991). And incidents of scientific misconduct, from fraud to misappropriation of research funds, are generating disputes over the accountability of science and the ability of scientists to regulate themselves.

Controversies over science and technology represent in part a loss of public trust, a declining faith in the ability of representative institutions to serve the public interest. Critics are asking about research priorities: Is science for the public or simply for the advancement of scientific careers? Are technological developments benefiting society or simply fulfilling narrow economic goals? The significance of controversies lies partly in their expression of political concerns; but they are also moral statements about the role of science. These two aspects of disputes—their political and moral dimensions—call for further analysis.

Controversy as a Political Challenge

The political challenge presented by science disputes varies, depending on the issue and the affected community. Some people become involved in protest because of their immediate and pragmatic interests. Living near a noxious facility or working in a chemical plant, they are directly affected by health risks or social disruption. But some issues have no natural constituency, attracting people who have no direct or pragmatic interest. In the debate over ozone depletion, for example, the affected interests are, for the most part, future generations. Animal rights protests attract those who are morally committed to the cause of animal protection. While some critics of biotechnology are concerned about specific economic or environmental impacts, others worry about the moral implications of “tampering” with life. Some risk disputes are motivated as much by ideological agendas as by fear of harm (Douglas & Wildawsky, 1984; Downey, 1986). The nuclear debate as it developed in the 1960s and 1970s, for example, had ideological overtones that had less to do with the technology than with its political context (Jasper, 1990). In such cases, political challenges come from people with a moral or social mission.

Most activists in science-based policy disputes are middle-class and educated people with sufficient economic security and political skill to participate in a social movement (McCarthy & Zald, 1973). Their involvement is not necessarily tied to traditional political alignments. The environmentalists who oppose technological projects and many animal rights advocates come from social movements associated with liberal values. But the prolife groups who oppose fetal research are politically conservative, as are the fundamentalists who seek to block the teaching of scientific theories that offend their faith. Focused on particular problems, science controversies attract people whose concerns rest more on the nature of the issue than on their prior political orientation as liberal or conservative, left or right.

Linking these diverse groups is their demand for greater accountability and increased public control. Technological controversies, as sociologist Alain Touraine has described them, represent a reaction against technocracy in the search for a more human-centered world (Touraine, 1980). This is the central political challenge of technological disputes.

Controversy as a Moral Crusade

Cutting across nearly all of these controversies are ubiquitous claims of “rights.” In the individualistic culture of America, nearly every political demand becomes cast in the moral rhetoric of rights—a rhetoric with deep roots in American history (Jonsen, 1991). The tendency to formulate problems in terms of distinct, overarching moral principles apart from their social context was nurtured by the religious tradition of Calvinism, and moralist thinking later permeated secular thought through the tradition of Puritanism (Miller, 1962).

Today, this tendency is reflected in the revival of bioethics as an influential profession. And it emerges in the discourse of social movements with their insistence on moral absolutes and claims for “rights.” Animal advocates call for animal rights, antiabortionists make claims for fetal rights, scientists claim the right to

conduct their research without unwarranted intervention, creationists claim their right to choose the theories taught to their children, and environmentalists advocate the rights of future generations.

Some claims to rights are based on obligations; rights may be a practical condition necessary to fulfill certain tasks. Thus government agencies claim the right to constrain individual freedom in order to carry out their mandated responsibilities. Other claims to rights are based on utilitarian arguments; certain rights are valued because they maximize the public interest. Scientists, for example, argue that the acquisition of knowledge is so important for the long-term interests of society that freedom of inquiry must override other considerations. Others, like animal rights advocates or creationists, base their claims to rights on basic moral or religious premises; and still others base their claims on the libertarian assumption that individual autonomy is an ultimate value in itself. But, whether justified in terms of natural rights, obligations, or traditions, rights claims become a moral imperative. Based on beliefs or deeply held intuitions that are considered nonnegotiable, they leave little room for compromise or accommodation.

Rights claims inevitably exacerbate conflict, for they are, as philosopher H. L. A. Hart (1955) observes, “moral justifications for limiting the freedom of another.” The claims on behalf of the rights of animals limit the freedom of inquiry that scientists believe their due. The rights of future generations constrain the actions of today's consumers. And rights to individual privacy conflict with the government's need to regulate for social ends.

In some controversies, claims to rights are little more than ad hoc responses in competitive situations, confusing moral categories with strategic goals. Indeed, the rhetoric of rights may be simply a way to elevate instrumental behavior to the level of a moral imperative so as to limit negotiation. Thus rights claims may be the central issue in a dispute, or simply a tactic, a way to gain public support in a controversial political context.

Tactical Considerations

The ideological complexity of technological controversies is often matched by strategic complexity as moral arguments are combined with extensive use of technical expertise. In some cases scientists have initiated controversies by raising questions about potential risks in areas obscured from public knowledge. Scientists were the first to warn the public about the possible risks of recombinant DNA research. They were the first to call public attention to the problem of ozone depletion. And they have been active on all sides of the diet-cancer disputes. But technical expertise is a crucial political resource in all policy conflicts; for access to knowledge and the resulting ability to question the data used to legitimize decisions are an essential basis of power and influence (Benveniste, 1972).

The authority of scientific expertise has rested on assumptions about scientific neutrality (Proctor, 1991). The interpretations and predictions of scientists are judged to be rational and immune from political manipulation because they are based on data gathered through objective procedures. Thus scientists are enlisted by all sides of disputes. Just as industrial advocates use technical expertise to support their projects, so too do

the protest groups who challenge them. Environmentalists hire their own experts, who expose potential risks. Among the animal rights advocates are scientists who debunk the need to use animals in research. Even the creationists present themselves as scientists and claim that creationism is a valid scientific theory that should be taught in the schools.

Though political values or moral issues may motivate disputes, the actual debates often focus on technical questions. Quality of life issues are discussed in terms of the physical requirements for a disputed facility or the accuracy of risk calculations rather than the needs or concerns of a community. Concerns about the morality of fetal research are reduced to debates about the precise point at which life begins. This displacement of issues can be tactically effective, for in all disputes broad areas of uncertainty are open to conflicting scientific interpretation. When decisions must be made in a context of limited knowledge, and there is seldom conclusive evidence to dictate definitive resolution, power may hinge on the ability to manipulate knowledge and to challenge the evidence presented to support particular policies. But as technical expertise becomes a resource, exploited by all parties to justify competing moral and political claims, it becomes difficult to distinguish scientific facts from political values. Debates among scientists reveal the value premises that shape the data considered important, the alternatives weighed, and the issues regarded as appropriate (Hilgartner, 1992).

Ironically, the willingness of scientists to lend their expertise to various factions in widely publicized disputes has undermined assumptions about the objectivity of science, and these are precisely the assumptions that have given scientists their power as the neutral arbiter of truth. Disputes among experts have thus brought growing skepticism about the policy role of scientists and awareness of the political dimensions of decisions commonly defined as technical. The very fact that experts disagree—more than the substance of their disputes—has forced disputes into the public arena, firing protest and encouraging demands for a greater public role in technical decisions.

Beyond seeking technical resources, those engaged in controversies over science and technology must organize their activities to broaden their political base. Many protest organizations—such as animal rights and ecology groups—rely on the backing of a direct mail constituency to provide political and financial support for their causes. To attract this support, they must generate dramatic and highly publicized events. Moving beyond routine political activities such as lobbying or intervention in public hearings, they engage in litigation, laboratory break-ins, street demonstrations, and other civil disobedience actions.

Litigation has been an important strategy, not only to block technologies but to mobilize constituents. In the 1970s the role of the courts in environmental decisions expanded through the extension of the legal doctrine of standing—private citizens without alleged personal or economic grievances could bring suit as advocates of the public interest.[5] The courts have since been used by citizens not only in environmental cases but also in challenging research practices, as in the litigation over fetal research and animal rights.

Such cases attract the media, bringing public visibility to the issues and amplifying the disputes.

Capturing public attention and political interest requires attracting the media (Mazur, 1981; Nelkin, 1994). Thus science protest movements engage colorful or visible writers and activists, such as Jeremy Rifkin, Peter Singer, Ralph Nader, and Paul Brodeur, and the support of film personalities and politicians. Visual imagery also brings attention to the cause. The gruesome photographs projected by the animal rightists attract public sympathy. Pictures of nearly full-term fetuses that look like infants fan public concerns about fetal research and tissue transplants. The television images of oil-coated birds inspire public outrage about supertanker oil spills. Rhetorical imagery is also strategically important. To scientists engaged in fetal research, the fetus is a "tissue"; to opponents, it is a "baby." Such verbal and visual images have helped turn abstract concerns about science and technology into moral missions.

The Resolution of Conflict

How one perceives science and technology reflects special interests and personal values. The social and moral implications of a particular practice may assume far greater importance than any details of scientific verification. Perceptions therefore differ dramatically:

- Will advances in biotechnology bring significant medical or agricultural benefits, or are they simply serving commercial interests?
- Is genetic screening in the workplace a way to protect vulnerable workers or an excuse to avoid cleaning up the environment?
- Are genetic engineering experiments creating humane and beneficial therapies or tampering with nature?
- Are nutritional guidelines and regulations of dietary claims a necessary and scientifically justified consumer protection or a form of government paternalism?
- Is animal experimentation essential to medical progress or an unnecessary moral affront to the rights of living beings?

The means to resolve disputes will depend on the nature of such perceptions. If disputes reflect competing interests as in many siting controversies, negotiations and compensation measures may reduce conflict and lead to resolution. But where moral principles are at stake, efforts to negotiate and compromise may fail to sway those who are committed to a cause.[6]

In some cases, dramatic events such as a major oil spill or the accident at Chernobyl have changed the terms of debate about certain technologies. In the late 1980s the growing concerns about global environmental issues projected the problem of ozone depletion onto the national agenda, and the tragedy of AIDS has forced the Food and Drug Administration to reconsider policies of drug approval and regulation. If the underlying stakes in disputes are economic or political, the discovery of new evidence may change the character of disputes. The arguments over the relationship between diet and cancer, and over the environmental affects of chlorofluorocarbons, have shifted over time. But in moral disputes, there is little evidence that technical

arguments affect the position of protagonists, for conflicting visions preclude closure. Thus disputes over animal rights or fetal research continue despite changes in research practices intended to accommodate public concerns.

Resolution of conflicts necessarily reflects the relative political power of competing interests. In some cases industrial interests prevail: Chemical firms are clearly important in framing the principles that shape the use of chlorofluorocarbons and the applications of biotechnology. But through persistence, protest groups have wielded considerable influence; antiabortionists and animal rightists have had a striking affect on research practices ranging from reforms to outright bans on certain types of research. And critics, calling attention to occupational carcinogens and the discriminatory implications of genetic testing in the workplace, have influenced legislation. Some controversies have resulted in government withdrawal of funding from projects (e.g., fetal research in the 1980s). And some scientists, hoping to avoid conflict, have voluntarily moved away from certain areas of research (e.g., on the XYY chromosome).

Ultimately, the implementation of science policy depends on public acceptance—or, at the least, on public indifference. Efforts to foster greater acceptance of science and technology have proliferated in the United States. Legislation provides public access to information through public hearing procedures and extended opportunities for intervention in rule making and adjudicatory procedures. Agencies have organized experiments in negotiation and mediation (Susskind & Weinstein, 1980). Citizens are often included in the advisory committees and institutional review boards overseeing research. Peer review groups, consensus panels, and special commissions are appointed to build public trust (Jasanoff, 1990a).

At the same time, controversies have sometimes led to the suppression of information that might arouse public concerns about potential risks. Secrecy can be a way to divert criticism, reduce the intrusion of burdensome regulations, prevent panic, and avoid costly delays. After the Chernobyl accident, federal agencies issued gag orders to energy agency officials and the several thousand scientists at national laboratories. They feared that disclosure of information to the press would result in hasty and inappropriate public responses to the controversial American nuclear power program (Nelkin, 1989, 1994). Chemical companies seek to restrict information about accidents until there is certainty about risk. In the context of controversy, public communication of information has become an increasingly sensitive issue (Jerome, 1986; Stevenson, 1980).

Based on competing social and political values, few conflicts are really resolved. Even as specific debates seem to disappear, the same issues recur in new contexts. Environmentalists' concerns about the instrumental use of nature were taken up by feminists and animal protectionists. The opposition to experimenting on vulnerable research subjects in the fetal research dispute extended to protests against research on the human embryo and on helpless animals. Risk issues are contagious; a problem in one location creates a public awareness that turns local issues into national disputes.

As conflicts persist, they continue to raise questions of control. What is the relevant expertise? Is responsibility for decisions to rest with those with technical know-how or with those who bear the impact of technological

choices? But controversies are increasingly expressing moral judgments as well as economic interests, and they are becoming crusades. The social movements organized to challenge science and technology are driven by a moral rhetoric of good and evil, of right and wrong. They are attracting constituents who fear the misuse of science by major social institutions, who see the need to reassess the social values, priorities, and political relationships underlying scientific and technological progress, and who see themselves as preserving the moral values lost in the course of technological change. Thus controversies matter and must be taken seriously as an indication of public attitudes toward science.

Notes

1. Case studies of these and other controversies can be found in Nelkin (1992).
2. For a review of the literature on science and technology policy emphasizing increasing concern with the problems of technology in the 1970s, see Nelkin (1977a).
3. This conference, organized by the International Council on Science Policy Studies, was held in Bielefeld, Germany, in May 1978.
4. For a literature review, see Nelkin (1987).
5. For a review and bibliography on citizen litigation, see Dimento (1977).
6. Engelhardt and Caplan (1987), *Scientific Controversies,* includes many cases demonstrating the difficulties of resolving disputes.

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