SUPPRESSION OF DISSENT IN SCIENCE

Brian Martin

ABSTRACT

There are numerous documented cases of attacks on dissident scientists, yet there is no established body of literature or standard theoretical frameworks for dealing with this phenomenon. Cases in three contentious areas—pesticides, fluoridation, and nuclear power—are used to illustrate processes and patterns of suppression. The evidence in these areas shows the possibilities and difficulties in drawing links between suppression and corporate, professional, and state power, respectively. Studies of suppression can provide a convenient probe into the exercise of power in science and more generally into the dynamics of expertise and legitimacy in a technological society.

The deployment of scientific and technological expertise is central to contemporary societies and, hence, it should follow that the exercise of power in society routinely and pervasively infiltrates technical domains. In speaking of power, it is possible to refer to several dimensions or faces (Abell 1977; Bachrach and Baratz

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1962, 1970; Lukes 1974), including the overt exercise of power over others to get one's way, the setting of agendas, and the shaping of people's beliefs. In the second, and especially the third, dimensions of power, powerful people and groups are able to get their way without the appearance of having intervened in a blunt fashion: their power has been naturalized and made to appear legitimate. Another way to conceive this is to say that power is thus embedded in systems of knowledge and understanding (Foucault 1973, 1977).

For any group that is able to acquire a disproportionate share of society's wealth, power, or status, it is advantageous for this inequality to be seen as legitimate. One of the key bases or supports for legitimacy in contemporary societies is scientific and technological expertise. Because scientific knowledge is widely believed to have an authority derived from nature, undisputed scientific knowledge claims can play a powerful legitimating role. When technical experts unanimously agree on a policy or practice, this provides a persuasive justification for that state of affairs. If all experts say, for example, that continents drift, that bridges are well designed, or that vaccinations are beneficial, then opposition to these views, if it exists, can be dismissed as uninformed. Unanimous expert support helps bring rewards for certain groups. Sometimes these rewards go primarily to expert researchers themselves, as in the case of funding for geologists who undertake studies about or presuming the validity of continental drift; sometimes they are also to companies, such as bridge builders; and sometimes they go to several groups, such as researchers, doctors, and pharmaceutical companies with a stake in vaccination programs.

Legitimacy based on science is precarious, however. A few dissenting experts are sometimes all it takes to turn unanimity into controversy. The existence of controversy, even when one side has many more numbers and prestige, usually serves to undercut the legitimacy of the dominant position (Mazur 1981; Scott et al. 1990).

When dissident experts challenge a scientific or technological orthodoxy, this potentially becomes a challenge to the privileges of groups associated with the orthodoxy, since the legitimacy of those privileges may be thrown into question along with the orthodoxy itself. In this situation, some of the groups that are able to exercise power against challengers may, on occasion, use their resources to do so. In other words, if a few scientists break ranks and question received ideas or even support the challengers, they pose a severe threat to interest groups associated with the dominant position and, therefore, are potential targets for attack. Many dissident scientists can be likened to heretics, as they are doctrinal critics working within the dominant institution. Attacks on heresy can serve to articulate the belief systems and social organization of both the institution and the challengers (Kurtz 1983). It is to be expected that wherever legitimacy supported by technical expertise is important—namely, in a vast range of areas—there is a reasonable chance that some cases may be found of the exercise of power to suppress dissent from dominant views.

What can be called suppression of dissent in science typically has two components. First, a scientist does something—research, teaching, making public state-

ments—that is perceived as threatening to a powerful interest group, such as a corporation, government department, or professional group. Second, agents or supporters of the powerful interest group make attempts to stop the scientist's activity or to undermine or penalize the scientist—for example, by censorship, denial of access to research facilities, withdrawal of funds, complaints to superiors, reprimands, punitive transfer, demotion, dismissal, and blacklisting, or threats of any of these.

In one circumstance, suppression of dissident scientists is well recognized: attacks on scientists because of their political views. In the late 1940s and early 1950s, during the period called McCarthyism, numerous left-wing scientists came under attack in the United States and a few other countries (Belfrage 1973; Buckley-Moran 1986; Caute 1978; Goldstein 1978). In the Soviet Union and other state socialist countries, dissident scientists were repressed like any other group (Popovsky 1980). Likewise, under authoritarian regimes. scientists can become targets of attack (Schoijet and Worthington 1993). However, in most of these cases, scientists have come under attack due to their political rather than their scientific views, though in some cases, such as Lysenkoism, scientific views have been defined as political by the state.

To help clarify the concept of suppression as presented here, it is useful to contrast it with several related but distinct concepts: repression, discrimination, whistleblowing, censorship, and self-censorship. When physical violence is used against opponents—including beatings, imprisonment, torture, and murder—this can be called repression, restricting the term "suppression" to restraint or inhibition without physical force (Martin et al. 1986, pp. 2–3).

Discrimination against people on the basis of sex, ethnicity, or some other such criterion can be considered suppression of a category of people. Alternatively, suppression of dissent can be considered discrimination on the basis of belief. Either way, there is a distinct difference: one discriminates on the basis of who people are, the other on the basis of what they say or do. Of course, in many practical situations, these ascribed and achieved characteristics are closely interlinked.

Whistleblowing can be conceived of as individual dissent that challenges a powerful interest group (Anderson et al. 1980; Bok 1980; De Maria 1995; De Maria and Jan 1996; Dempster 1997; Devine and Aplin 1986; Elliston et al. 1985a, 1985b; Ewing 1977; Glazer and Glazer 1989; J. Graham 1986; Hunt 1995; Lampert 1985; Miceli and Near 1992; Mitchell 1981; Nader et al.1972; Perrucci et al. 1980; Peters and Branch 1972; Petersen and Farrell 1986; Vinten 1994; Westin et al. 1981). Almost all the whistleblowing literature is couched in terms of individual employee dissent and thus misses much of the insight to be gained by examining systems of power and patterns of control. The concept of whistleblowing also fails to incorporate many types of suppression, such as blocking of publications, that do not involve principled organizational dissent. Whereas the study of whistleblowing leads to a focus on individual behavior, the study of suppression leads to a focus on the exercise of power. In spite of differ-

ences in emphasis, though, there is much in common between studies of whistleblowing and of suppression.

Censorship is one means of suppressing dissent, but not all suppression takes the form of censorship. Cases of overt, external censorship, which pose ample methodological challenges of their own, are relatively unproblematic compared to self-censorship, which is when people consciously or unconsciously decide not to speak out due to the likely consequences or because their beliefs have adapted to the realities of what is commonly considered to be allowed.

As a result of conversations with numerous scientists (Martin 1997), it is my observation that quite a number of scientists avoid doing research or making statements on sensitive issues because they are aware, at some level, of the danger of being attacked if they do. This is compatible with the findings of Wilson and Barnes (1995), who surveyed 70 senior Australian environmental scientists, asking, among other things, "Do you believe that scientists may jeopardize their career prospects or research funding success by speaking out on environmental issues?" More than half replied "yes," and less than one in five replied "no," the rest being unsure.

In this context, it is worth quoting C. Wright Mills' comment on university teachers: "the deepest problem of freedom for teachers is not the occasional ousting of a professor, but a vague general fear—sometimes politely known as 'discretion,' 'good taste,' or 'balanced judgment.' It is a fear which leads to self-intimidation and finally becomes so habitual that the scholar is unaware of it. The real restraints are not so much external prohibitions as control of the insurgent by the agreements of academic gentlemen" (1963, p. 297). Still, despite the importance of self-censorship, I have restricted the focus in this paper to cases of overt suppression. Dealing with self-censorship introduces psychological dimensions and would require a theory of psychology, plus the need to theorize links between direct suppression and self-censorship and between systems of power and self-censorship.

There are many cases in which dissenting scientific expertise poses a threat to powerful interests, and as shown later, there is extensive evidence about suppression of dissent in science. Whatever one's assessment of charges about suppression, it might be expected that this evidence would be the subject of intense sociological investigation, given the light it could throw on the uses of expertise in a technological society. To the contrary, though, there is no body of work in sociology on the topic and no standard theoretical frameworks for dealing with it. Indeed, although in the sociology of science there are many different approaches and schools of thought (Jasanoff et al.1995), in none is there significant attention to claims about suppression. This includes early historical and philosophical studies of how human concerns and social processes are deeply embedded in scientific practice and knowledge (Feyerabend 1975; Hanson 1958; Hesse 1974; Kuhn 1970; Polanyi 1958); the political critique of science, which analyzes the influence of social structures, such as capitalism, religion, and the state, on the development

of science (Arditti et al. 1980; Bukharin et al. 1931; Dickson 1974, 1984; Merton 1938; Rose and Rose 1969, 1976a, 1976b); controversy studies (H. Collins 1981; Engelhardt and Caplan 1987; Mazur 1981; Nelkin 1979); the sociology of scientific knowledge and related constructivist analyses of science (Barnes 1974, 1977, 1982; Bloor 1976; H. Collins 1985; Knorr-Cetina 1981; Mulkay 1979; Pickering 1984; Pinch 1986); actor-network theory, in which knowledge is seen as a contingent, locally constructed, and historically situated outcome that is intimately linked with the negotiations of human and nonhuman actors (Callon and Law 1989; Callon, Law, and Rip 1988; Latour 1983, 1987, 1988; Law 1986; Law and Callon 1988); and critiques of scientific epistemology and power (Aronowitz 1988; Rouse 1987). Most science studies analysts treat scientific discourse as relatively "free," in the sense that there are influences and incentives but no bludgeons affecting the ability of scientists to speak; the possibility of systematic squashing of speech and activity in whole areas of science in "free" societies is given little attention. In spite of the large number of cases and considerable documentation, very few social analysts of science (see especially Abraham 1995; Hess 1992; Martin 1986, 1988, 1991) have investigated attacks on dissident scientists. The scarcity of treatment provides a potent demonstration of the nonneutrality of the literature.

The next section addresses the issue of how to determine whether actions should be categorized as suppression. In the following three sections, evidence is cited for the existence of suppression in three contentious areas: pesticides, fluoridation, and nuclear power. The links between suppression and corporate, professional, and state interests, respectively, are discussed, noting in particular the difficulties in drawing simple connections. The semi-final section deals more generally with suppression and power, in particular noting a link between suppression and hierarchy in science. The final section suggests some possibilities for future research in what can be called comparative suppression studies.

STUDYING SUPPRESSION

A "system of power" is used here as a shorthand for a set of patterned social relationships, usually reaffirmed but sometimes challenged by the behavior of individuals, which provides differential opportunities to groups and individuals to influence the behavior of others. A system of power in this usage is compatible with a nonreified interpretation of social structure; it is intended to refer both to power associated with social structure and to power exercised on a local scale, for example, between individuals within an organization. It is to be expected that different frameworks for studying power—for example Barnes (1988), Clegg (1989), Lukes (1974), Parenti (1978) and Wrong (1979)—will be useful for different sorts of analyses. For analyzing suppression in science, the concepts of interest and resource are quite useful.

If a system of power provides resources that might be used for attacking dissident scientists, it is worth investigating to see if there are actual cases that fit this pattern. Three important systems of power are those involving economic, status, and state interests. In the following sections, three areas are examined, each one illustrating a potential link between a category of interests and suppression of dissent in science. In the case of pesticides, the financial interests of pesticide companies are central; in the case of fluoridation, the status interests of the dental profession are central; and in the case of nuclear power, the interests of state agencies in control are central. In each of these areas, there is considerable documentation about suppression of scientific dissent. One of the questions to be addressed is whether it is possible to draw a connection between the central interest group and the exercise of power to suppress dissent. But before addressing the case studies, it is useful to address some preliminary issues.

In any analysis of power and dissent, it is vital to determine how to distinguish suppression from actions taken for legitimate reasons. If a scientist is dismissed, how can anyone tell whether it is due to suppression or simply to poor performance? Ultimately, there is no way to *prove* that suppression is involved in any particular case, but there are several ways to determine whether suppression is a likely possibility. A useful tool is the double standard test: is a dissident scientist treated any differently from other scientists with similar records of performance? If a scientist who has spoken out about a chemical's potential to cause cancer is demoted for allegedly poor performance, but other scientists with similar or worse performance records are not demoted, then this suggests that suppression is involved. The dissident scientist is apparently being treated according to a standard different from that used for other scientists.

Suppression is easiest to discern when the action taken is unusual and information is available to apply the double standard test. Dismissals of scientists are uncommon and, often, records are available of publications, reviews of performance, and the like, so the double standard test can be applied straightforwardly. Suppression can also occur through blocking of publications, appointments, and research grants. But because publications, appointments, and research grants are routinely denied for conventional reasons (poor quality, better candidates available), and because the information on which such decisions are made is seldom publicly available, it is extremely difficult to show suppression in these areas.

Another way to assess whether suppression is involved is to examine actions in relation to commonly accepted standards of behavior. If someone disagrees with a scientist's research conclusions or public statements, an accepted method of response is to criticize the argument, for example, by sending a letter to the scientist or to a journal. By contrast, sending a letter of complaint to the scientist's boss or funding body, attacking the scientist's credibility or right to speak out, would be seen by many as an attempt to apply pressure on the scientist rather than address the issues under dispute. Still, care has to be taken in applying this method, since

accepted standards of behavior can vary from situation to situation. Abusive verbal attacks on a scientist's personal character might be considered outrageous in one research culture but treated as an extravagant but tolerable manifestation of vigorous intellectual jousting in another.

Another reason to suspect suppression is the existence of a pattern of attacks in a similar area, as will be illustrated in the cases of pesticides, fluoridation, and nuclear power, where there are theoretical reasons to expect suppression—namely, the existence of a powerful interest group that has established a routine connection with science, and a challenge to this group from a subordinate or peripheral group. Any single case considered in isolation is open to the criticism that it may have been an exceptional occurrence or due to peculiar factors; it is only by considering many cases in a given area that it is possible to demonstrate patterns of suppression. Many of the cases described and cited here involve serious attacks on the careers of scientists, such as formal reprimands, forced transfers, and dismissals. Another dimension to suppression operates at the level of belief systems and manifests itself most commonly through peer review, such as blocking of publications. This sort of suppression is difficult to document and, indeed, difficult to distinguish from the "normal" operation of science. One view is that closure in scientific controversies is built on suppression of divergent viewpoints. This sort of paradigm-level suppression is apparent in areas that range from continental drift (Frankel 1987) to theories about the origin of AIDS (Martin 1993). In this paper, however, cases of suppression via paradigm commitments and peer review are used only as supplements to suites of cases using a range of other methods.

There is insufficient space in this paper to provide full detail on even a single case, which itself may require a full article in itself, if not a book—see, for example, Adams (1984), Anderson et al. (1980), Bell (1994), Dixon (1976), Efron (1972), and Sarasohn (1993). Hence, references to more detailed treatments will be provided, but the cases will be described only briefly; indeed, the availability of documentation is one reason for focusing on the areas of pesticides, fluoridation, and nuclear power. Although these may seem to be "old" issues, the controversies continue, and new suppression cases have been reported in recent years. Although in each controversy, the opposition has made considerable advances, this does not mean that suppression is unimportant in the dynamics of these issues, any more than the demise of McCarthyism in the United States means that the techniques used against dissidents then are of little significance or not worth studying today.

Although the study of suppression can be a powerful way of understanding the exercise of power in science, investigators face several problems. It is no trivial matter to collect information on cases of suppression. Most cases are not well known; to uncover and analyze even a single case can be a difficult and time-consuming task. Attacks on scientists are almost never characterized, by the perpetrators, as suppression of dissent. For an investigator to use such a label, or even to seek details about cases, can be interpreted as demonstrating bias and, in contemporary cases,

such actions are likely to be threatening to both elite scientists and relevant interest groups. Just as there is no neutral way to study scientific controversies (Scott et al. 1990), there is no truly neutral way to study suppression in science; instead, in this case as in cases of power-knowledge generally, a commitment by the analyst sometimes can be argued to provide the foundation for, rather than an obstacle to, a useful investigation (Jansen 1988, p. 183; Martin 1996b; Shrader-Frechette 1994).

The mere fact that some participants on one side in a controversy are suppressed, finally, does not necessarily make that side either correct or virtuous. Suppression is the exercise of power against dissent. Commonly, there are some on each side who might be willing to suppress the other, in certain circumstances. The cases recounted in Hentoff (1992) show this willingness in the case of U.S. social movements. Typically, however, only one side has the resources to be able to do so, meaning that the social study of suppression is not a study in virtue but, rather, a study of the exercise of power.

In each of the following three sections, one case is described in a few paragraphs, followed by a few briefer accounts, and finally there are references to many other cases. The assessments and generalizations made are based on all the cases cited, not just the ones recounted here. The brief treatments here cannot begin to give an adequate description or analysis of any case and are intended only to give a flavor of the sorts of cases about which documentation is available.

PESTICIDES

Pesticides are chemicals designed to kill insects, plants, fungi, and other life that is considered to be undesirable for human purposes, especially agriculture and public health. Supporters argue that pesticides are essential for these purposes, whereas critics argue that many uses of pesticides are unnecessary or harmful to the environment and human health. The debate over pesticides has raged since the 1960s (for reviews, see Bosso 1987; Hay 1982; Ordish 1976; Perkins 1982).

- Dr. Melvin Dwaine Reuber is a research scientist who became one of the world's leading critics of pesticides through his studies of their link with cancer. Through the 1960s and 1970s, he had a productive and successful career, publishing over 100 scientific papers and establishing himself as a top scientist in a well-paying job. In 1981, he was head of the Experimental Pathology Laboratory at the Frederick Cancer Research Center, part of the National Cancer Institute in the United States. Then, suddenly, he received a blistering attack on his performance and professional behavior from the director of the Center, Dr. Michael G. Hanna, Jr.—who had previously given him the highest commendations. The reprimand from Hanna questioned the quality of Reuber's studies of carcinogenicity of pesticides and also called him to task for using Center letterhead for a letter that allegedly reported his private work.

Even more seriously for Reuber, the substance of Hanna's letter appeared shortly afterwards in *Pesticide & Toxic Chemical News* ("Dr. Mel..." 1981), a newsletter of the petrochemical industry. Copies were circulated widely and used by industry to discredit Reuber and his work (Honorof 1988; Marshall 1984; Martin 1996a; Nelson 1981; Rushford 1990; Schneider 1982).

The attack on Reuber served the interests of the pesticide industry, given that his work was a serious threat to it. His studies were important in bans placed on leading pesticides aldrin, dieldrin, chlordane, and heptachlor, and his work was used around the country by opponents of pesticides. He was willing to write letters about his results, realizing that they would be used in local anti-pesticide campaigns.

Reuber subsequently sued *Pesticide & Toxic Chemical News*. (He won substantial damages in a lower court but finally, a decade later, lost on appeal. Whether winning or losing a court case tells anything about whether suppression is involved is something that has to be examined in each individual instance.) The court case revealed that pesticide interests had complained to the National Cancer Institute about Reuber. One of these complaints had led Hanna to make an investigation that led to his reprimand.

- Clyde Manwell, professor of zoology at the University of Adelaide in South Australia, coauthored a letter published in the local newspaper which questioned some aspects of government spraying for fruit fly. He was fiercely attacked in state parliament, and the university initiated an attempt to dismiss him (Baker 1986).
- Robert L. Rudd's book *Pesticides and the Living Landscape* (Rudd 1964), which raised concerns similar to Rachel Carson's *Silent Spring* (1962) and was completed earlier, was delayed and excessively scrutinized—by 18 reviewers—before being published by the University of Wisconsin Press. "He lost a promotion, and his very position with the University [of California] was threatened" (Graham 1970, p. 168).
- After *BioScience* published an article by Frank E. Egler (1964) that criticized pesticides, both the journal and author were censured in a motion at a meeting of the Entomological Society of America, a professional body supported by pesticide manufacturers, even though the article would not have been seen by most of those present (Graham 1970, p. 171; Judson 1965; van den Bosch 1978, p. 71).

These are a few of the many documented cases of attacks on scientist critics of pesticides (see also Baker and Manwell 1988; Boffey 1968, pp. 632–633; Carr 1986; Coppolino 1994; Epstein 1978; A. Freeman 1993; Graham 1970; Martin 1996a; Martin et al. 1986, pp. 123–163; McKenna 1992; van den Bosch 1978, pp. 47, 61–71, 102–107, 119–137, 196–197). In a typical case, a scientist does research that is potentially threatening to the pesticide industry or speaks out critically about pesticides, and is attacked in some fashion.

Common methods include withdrawal of research funding, threats, and attempts at dismissal.

Suppression of scientist critics of pesticides appears to serve the interests of the agrichemical industry. The use of manufactured chemicals in agriculture, especially pesticides and fertilizers, became a substantial industry after World War II. This was part of a new model for agriculture, based on large monocultures, expensive machinery, less labor, and increased corporate control over the process of farming. The preferred industry solution to the problem of pests was pesticides. Vast amounts of money were poured into promotion of the "pesticide paradigm," which became the scientific as well as the commercial standard in a variety of ways (van den Bosch 1978).

There were some critics of these developments, both scientists and nonscientists, but they had little impact until the rise of the environmental movement. Rachel Carson's classic book *Silent Spring* (1962), a prime catalyst for the movement as a whole, was a sustained critique of the abuse of pesticides. The synergistic combination of citizen activists and scientist critics provided a formidable challenge to the pesticide establishment. Activists without scientific credentials could be dismissed as uninformed, while critical researchers without community backing could simply be ignored. One way to undermine the combined forces of activists and scientists is to attack the scientist critics. The attacks on Reuber and others can be seen in this light.

Linking the pesticide industry to attacks on "dissident" scientists seems easy enough on the surface, but a closer look shows many theoretical complications in using this process to probe links between systems of power and social action. In most general terms, the relevant system of power is capitalism, but it would be difficult to argue that the interests of the pesticide industry are identical to those of the capitalist class as a whole. Arguably, alternatives to pesticides such as integrated pest management might be just as valuable for the overall rate of profit. (Explaining the success of pesticide interests compared to alternatives is a major research project in itself—see Perkins 1982.) The terms, accordingly, need to be reduced to a sector of the capitalist class, namely, the pesticide industry.

In most documented cases of suppression of scientist critics, the pesticide industry is involved only indirectly, if at all. A direct involvement would be the dismissal of a scientist critic who worked for a pesticide company. Such cases may exist, but they are seldom documented. A plausible explanation for the lack of such cases is that scientists working for industry, as well as being self-selected and acculturated to an industry perspective, are also well aware that openly opposing their employers may well mean the loss of their jobs. Thus, those who are least vulnerable to direct reprisals are the ones who are most likely to find the support and freedom to undertake critical research and to speak out. Arguably, if Reuber had worked for the chemical industry, for example, studies of the sort he actually did might not have been funded, he

might not have been allowed to publish his results, and, if he had persisted in finding unwelcome results, his career might well have been terminated before he became prominent.

The industry, when it is involved in attacks on scientists employed elsewhere—most commonly, government or universities—typically makes complaints to the supervisor or employer of a scientist. It is a characteristic feature of suppression cases that criticisms are made not directly to the scientist—which would be a proper part of scientific dialogue and debate—but to the scientist's boss. It is undoubtedly the case that there are many more informal complaints—for example, over the telephone—than formal written complaints. When applying this sort of pressure, the industry can only succeed to the extent that it has allies or sympathizers in powerful scientific positions. Therefore, an understanding of the suppression of critics of pesticides requires an understanding of the relationship between industry and the bureaucratic structure of scientific workplaces, as will be discussed later.

Yet another complication is that many attacks on critics of pesticides come from government bodies. For example, many of the attacks described by van den Bosch (1978) involve the U.S. Department of Agriculture. In a number of examples, government agencies seem more ardent in their support of pesticides than do pesticide companies themselves. This can be explained as an example of a "captured bureaucracy" (Mitnick 1980; see also Freudenburg and Gramling 1994), as a feature of the "capitalist state" (Jessop 1982), or as an aspect of the inevitable state involvement in creating markets for capital (Heilbroner 1985, pp. 78–106; Moran and Wright 1991).

In summary, in the case of pesticides, it makes sense to speak of a link between the pesticide industry and attacks on scientist critics of pesticides. Suppression can be conceived of as a means that uses and reinforces the power of a particular industry. It also highlights the many qualifications necessary in drawing a link between systems of power and social action.

FLUORIDATION

Fluoridation, the addition of one part per million of fluoride to drinking water as a means of preventing tooth decay in children, was endorsed by the United States Public Health Service in 1950 and promoted heavily thereafter, with strong support from the American Dental Association. A substantial fraction of the population in Australia, Canada, New Zealand, and the United States drinks water with added fluoride, but fluoridation is uncommon elsewhere in the industrialized world. From the beginning, there was substantial citizen opposition to fluoridation, but there were few dentists, doctors, or scientists who openly opposed the procedure.

- Dr George Waldbott was the leading scientist opponent of fluoridation in the United States from the late 1950s through the 1970s. He wrote articles and books, testified at numerous inquiries, and was the focal point for the U.S. antifluoridation movement. A prominent allergist and author of hundreds of scientific papers, Waldbott's submissions concerning hazards of fluoride to certain journals were routinely rejected, and he reported having reason to believe that the editors and the U.S. Public Health Service were in communication about this (Waldbott 1965, p. 323).

  Much more threatening to Waldbott, though, was the American Dental Association's dossier on opponents of fluoridation. Compiled by the ADA's Bureau of Public Information, this dossier contained letters and extracts from newspapers and other sources. Many of those listed in the dossier, such as the Ku Klux Klan and various fringe practitioners, were easy to discredit or ridicule. Along with many apparently dubious characters and organizations, however, the dossier listed some whose credentials and professional achievements would normally be seen as conferring respectability, but the implication of the dossier was that all opponents of fluoridation were cranks, through a form of guilt by association. Furthermore, the material in Waldbott's entry was questionable. Some of it was based on a visit to Waldbott by a visiting German pro-fluoridationist who misrepresented his intentions to Waldbott, gained access to Waldbott's files on studies of patients with adverse reactions to fluoride, and wrote a letter about his visit to a leading U.S. pro-fluoridationist; extracts from this letter appeared in the dossier. The dossier was twice published by the prestigious *Journal of the American Dental Association* (Bureau of Public Information 1962, 1965), and it was circulated throughout the country and even overseas, being used against Waldbott wherever he visited (Waldbott 1965).
- John Colquhoun, of the Department of Health in Auckland, New Zealand, spoke publicly about the risk of fluoride poisoning from small children swallowing toothpaste. He was formally warned to stick to official policy (Colquhoun 1987, p. 231).
- Max Ginns was expelled from his dental society in Worchester, Massachusetts, in 1961 after he circulated a petition of dentists and doctors opposed to fluoridation (Waldbott et al. 1978, pp. 325–326).
- Mien Bulthuis wrote a dissertation on fluoride's role in inhibiting the enzyme cholinesterase. The Chief Inspector of Health in the Netherlands applied pressure on the Netherlands Health Board to prevent publication of the dissertation, because it might add to public concern about fluoride (Moolenburgh 1987, p. 107).

Waldbott, because of his prominence in the antifluoridation cause, was informed of numerous other cases of suppression (Exner and Waldbott 1957, pp. 184–191; Waldbott 1965; Waldbott et al. 1978, pp. 318–352). In addition, there

are many other documented cases (Caldwell and Zanfagna 1974; Colquhoun 1987, pp. 231–232, 311–312; Diesendorf 1996; Groth 1973, pp. 179–185; Martin 1988, pp. 337–342; Martin 1991, pp. 68–102; Moolenburgh 1987, pp. 24–25, 47; Sutton 1980, pp. 23–33; Yiamouyiannis 1986). Some of the common types of attacks include threats to deregister dentists and warnings from superiors to desist from statements about hazards of fluoridation. There are also a number of instances in which editors or referees opposed publishing articles because the articles might aid the antifluoridation cause, including one in which submissions from a scientist known to oppose fluoridation were returned without being opened (Waldbott et al. 1978, pp. 334–335).

The proponents of fluoridation have been highly successful in stigmatizing critics as reactionary, irrational, confused, and unscientific and even in claiming that fluoridation is so well verified that there is no scientific debate. Most social scientists have accepted that fluoridation is scientifically beyond question and have examined only social explanations for opposition to fluoridation (Martin 1989). There is, indeed, much reputable scientific research backing fluoridation (Murray and Rugg-Gunn 1982; Newbrun 1986), but there is also some scientific work arguing both that the health hazards of fluoridation are significant and that the benefits are less than claimed (Diesendorf 1986; Waldbott et al. 1978).

In the struggle over fluoridation as a public health measure, the struggle over knowledge claims concerning the benefits and hazards of fluoride has played a key role. The few critics who are scientists, doctors, or dentists have a significance beyond their numbers, since they change the situation from one of unanimity concerning knowledge to one of conflict. It is in this context that occasional instances of suppression of scientist critics can be understood as an important method of waging the struggle for fluoridation.

Arguably, the key driving force behind the promotion of fluoridation has been the dental profession (Martin 1991; Varney 1986). Rather than using the traditional idea of professions as altruistic bodies of practitioners, professions are treated here as systems of power—specifically, as ways to organize an occupation to garner status and wealth (R. Collins 1979; Freidson 1970; Johnson 1972; Larson 1977; Willis 1983). Dentistry can be fruitfully analyzed in this way: it involves lengthy training and certification by the profession itself; it is oriented around professionals treating individuals rather than changing social structures; and it is built on a body of esoteric, scientifically validated knowledge (Davis 1980).

The promotion of fluoridation, while in conflict with the idea of individual treatment, did not pose a threat to dental practice, since there are many more dental problems than can be dealt with individually by dentists. Fluoridation, whose justification is based on sophisticated scientific methods such as epidemiology, promised to increase the scientific status of dentistry, which was otherwise associated with mechanical techniques such as filling of teeth. Finally, a

number of prominent dental researchers stood to build their reputations on the promotion of fluoridation, and did so (Martin 1991; Varney 1986).

Thus, in contrast to the cases of pesticides and nuclear power, the material interests of the key system of power—the dental profession—are much less significant than its status interests. Generally speaking, it is in those countries where the dental profession has the greatest degree of control over working conditions and entry to the profession, namely, the English-speaking countries, where fluoridation has been most strongly promoted and widely adopted.

In some countries, the state has played a supporting role in the promotion of fluoridation, by providing endorsements, funding research, and, in some cases, mandating fluoridation. This can largely be attributed to the efforts by advocates within the dental profession. For example, it was vigorous lobbying by fluoridation proponents that led to the original endorsement of fluoridation by the U.S. Public Health Service (McNeil 1957). That there is no special state interest in fluoridation is suggested by the decisions made against fluoridation by many European governments, in spite of support for it from the dental profession, and the attempts by many local governments in the United States to avoid responsibility for making a decision about fluoridation, for example, by calling referenda (Crain et al. 1969).

Many anti-fluoridationists argue that industrial interests are behind fluoridation, notably, the aluminum industry (which produces fluoride wastes), toothpaste manufacturers (for which fluoride is a promotional element), and sugary food manufacturers (for which fluoride provides a magic-bullet solution to tooth decay, diverting attention away from the well-established role of sugar in tooth decay). There is little evidence showing any direct involvement by the aluminum industry or toothpaste manufacturers in promoting the fluoridation of public water supplies, although some financial support comes from sugary food industries. Instead, almost all the direct promotion, and also almost all of the instances of suppression of scientist critics of fluoridation, are linked with the dental profession or its allies in the state. It can nevertheless be argued that commercial interests have provided a context in which the dental profession found the promotion of fluoridation a path of least resistance from powerful interests, compared, for example, to challenging the sale and consumption of sugary food (Martin 1991, pp. 115–130).

The fluoridation debate thus provides a good case study of the dynamics of science as a system of power-knowledge in which the key interest group is a profession. Scientific knowledge and the authority to pronounce on scientific knowledge have been crucial in the debate, both as resources in the struggle and as outcomes of it. Suppression of scientific dissent seems to have played a significant role in this struggle.

NUCLEAR POWER

Nuclear power is a method of producing electricity by harnessing the energy released by nuclear fission. Proponents argue that it is a safe and economical way of producing necessary energy; critics argue against nuclear power on various grounds, including hazards (nuclear reactor accidents, long-lived radioactive waste), proliferation of nuclear weapons, high economic cost, and the political restrictions associated with a "plutonium economy."

- The U.S. Atomic Energy Commission (AEC) in 1965 funded a long-term study of the health effects of low-level ionizing radiation under the supervision of Dr. Thomas Mancuso, an epidemiologist at the University of Pittsburgh. In 1974, before Mancuso had reported any results, another researcher, Samuel Milham, reported an increase in cancers at the AEC's plant at Hanford, Washington. The AEC pressured Mancuso to repudiate Milham's claims, but he refused on the grounds that his study was not complete.
  The AEC, apparently unhappy with Mancuso's refusal, arranged for a review of the study. ("AEC" will be used throughout here, although the agency's name later changed.) There were six reviewers: four were favorable and only one recommended termination and transfer to another school of public health. Nevertheless, the AEC terminated the study, citing only the two negative reviews, and transferred it to a private company, Battelle West, under the supervision of the former AEC employee who, as a reviewer of Mancuso's study, had recommended its termination (Bertell 1985; Bross 1981, pp. 217–222; L. Freeman 1981, pp. 41–42; Sterling 1980; Wasserman and Solomon 1982, pp. 141–144).
- Ross Hesketh, a nuclear physicist at the Central Electricity Generating Board in Britain, spoke out about the use of plutonium from civil nuclear power plants for military purposes. He was disciplined, harassed, transferred, and finally dismissed (Dickson 1983; Edwards 1983).
- Jens Scheer, a nuclear physicist at the University of Bremen, was a leftist and critic of nuclear power. The university suspended him and tried to dismiss him from his post (Nelkin and Pollak 1981, p. 92; Piper 1975).
- Atsushi Tsuchida, a physicist working at the Institute of Physical and Chemical Research (known as Riken) in Japan, was critical of nuclear technology and wrote for a wide audience. Riken did not list his publications, denied him a salary increase (considered a harsh punishment), and prevented him from giving outside lectures (Siratori n.d.).

These examples are among numerous cases from around the world of attacks on scientists and engineers whose work or statements aid the case against nuclear power (see also Clarke 1997; Craddock 1994; L. Freeman 1981; Grossman 1996; Hatzfeldt 1989; Jungk 1979, pp. 85–107; Martin 1986; Pooley 1996;

Sharma 1983, pp. 120–126; Sharma 1996; Sutcliffe 1987, pp. 38–58). Common types of attacks on scientist critics of nuclear power include transfer to different jobs, withdrawal of research funding and staff, blocking of publications, and dismissal. A large number of these cases involve employees of government research laboratories. Employees of private firms in the nuclear industry may be even more vulnerable to attack and, hence, are unlikely to try to retain their jobs while being openly critical. Perhaps realizing this, three General Electric nuclear engineers who openly criticized nuclear power in 1976 resigned at the same time (L. Freeman 1981, pp. 258–292). Critics within universities are more protected from dismissal, although research funding can be withdrawn, as in the case of Mancuso.

The promotion of nuclear power is closely linked to state power (Camilleri 1984; Gorz 1980; Jungk 1979). In nearly every country, nuclear power is state-owned and state-run. Only in the United States has private industry played a significant role; even so, the U.S. government has provided crucial support via regulation, limiting legal liability in the case of reactor accidents, and controlling key parts of the nuclear fuel cycle (uranium enrichment, reprocessing). The central role of the state in nuclear power stems from historical links with nuclear weapons production (always a state enterprise), which have persisted due to the potential role of civilian nuclear power in proliferation of nuclear weapons. Also important are the enormous scale and potential danger of nuclear power, which make private involvement risky without government guarantees, and which have involved the state in order to prevent terrorist and criminal use of nuclear materials. Critics would also argue that nuclear power has seldom been a commercial proposition and, hence, government backing—whether provided for military, status, or social control purposes—has been essential. When the British government privatized its electricity industry, for example, parts of the nuclear industry were exempted and remained under government ownership.

In the 1960s and especially the 1970s, a worldwide movement against nuclear power developed (Falk 1982). Many of the key arguments raised against nuclear power involved technical dimensions, such as the risk and consequences of nuclear reactor accidents, the possibility of safe disposal of long-lived radioactive waste, and the feasibility of alternative "energy paths" (Lovins 1977). Of nuclear scientists and engineers who have been willing to take a stand, most supported nuclear power, especially in the early years of the debate. Those few who questioned the orthodoxy were a great threat, since they undermined the apparent unanimity of expert support for the technology. The occasional instances of suppression of nuclear dissidents can be interpreted as a response to this threat.

SUPPRESSION AND POWER

The previous three sections cite considerable evidence that some scientists critical of pesticides, fluoridation, or nuclear power have been attacked because of their views or statements. References to many cases of suppression were given, but these are likely to be only a fraction of those that have occurred. No doubt others are to be found in the unsystematic "literature" on suppression, but more importantly, documented cases are only a fraction of actual ones, since many are hushed up by all parties. The documented and publicized cases overrepresent certain types of cases (such as dismissals and attacks on prominent individuals) and underrepresent others (such as denial of appointments and blocking of publications). In spite of these obstacles, the evidence in the three areas chosen is revealing, and it is too substantial to be ignored.

While suppression is sometimes effective in silencing individual dissidents, it may be even more effective in signaling to others what they might face if they step out of line. It can also discourage investigators from undertaking certain lines of research (Deyo et al. 1997). On the other hand, suppression sometimes can be counterproductive, for example, when it is grossly unfair, exposing the raw face of power and stimulating greater dissent (cf. Molotch 1970). A full discussion of the effectiveness of suppression and of the strategies against it is beyond the scope of this paper (but for relevant observations, see especially Devine 1997; Martin 1997; Pring and Canan 1996). Nevertheless, one irony is worth noting. As noted earlier, legitimacy is enhanced when it seems to be natural, with no overt exercise of power, and unanimity of scientific expertise is one powerful way to establish legitimacy. Attacks on dissident scientists are one way to try to enforce unanimity, yet by their nature, many of these attacks involve the blatant exercise of power, and if publicized, they potentially undermine the appearance of legitimacy based on knowledge alone.

Suppression of dissent provides a direct link between power—inside and outside of science—and what is accepted as scientific knowledge. In the controversies over pesticides, fluoridation, and nuclear power, what is accepted as scientific knowledge is central to the dispute: it is affected by the exercise of power in the controversy, and it is a tool used in that exercise. A few studies explicitly emphasize how scientific knowledge is deeply embedded in these disputes (Diesendorf 1982; Martin 1991; Sterling 1980; see also Abraham 1993, 1994, 1995; Walker 1993).

The three case studies presented here, of pesticides, fluoridation, and nuclear power, suggest a link between suppression of dissent and three systems of power, namely, corporate power, professional power, and state power, respectively. Several factors support the case for a linkage between a system of power and a pattern of suppression—interests in a particular stance on the issue in question; a challenge to the interests; a key role for dissident experts in supporting the challenge; and direct or indirect use of power to attack some of the dissidents. In the case of pesticides, for example, certain chemical companies make a profit by selling

pesticides; the environmental movement has challenged the use of pesticides; scientists who are critical of pesticides have played a key role in providing legitimation to the environmental movement challenge; and some of the attacks on scientists critical of pesticides come directly from industry.

If corporate power, professional power, and state power can be linked to patterns of suppression, what about other systems of power? Patriarchy is a promising area to study. There is a growing number of studies of patriarchy and science (Bleier 1986; Brighton Women and Science Collective 1980; Harding 1986; Keller 1985), but what about patterns of suppression? There is certainly considerable evidence of discrimination against female scientists and failure to give adequate recognition to their work (Niven 1988; Rossiter 1993; Sayre 1975; Theodore 1986), but arguably, this sort of discrimination is different from suppression of dissent as it is conceptualized here. On the other hand, there is some evidence of suppression of vocally feminist scientists and of suppression of research that challenges beliefs about male biological superiority or that in other ways challenges male privilege (Bleier 1984; Masson 1984). More research is needed into these types of suppression. Also, it is likely that the way in which science interacts with patriarchal power is quite different from the way it interacts with corporate, professional, or state power. Other power systems worthy of study in relation to suppression in science are racism, the military, heterosexism, and oppression of and in the Third World.

One thing that is quite clear from studies of suppression cases is the large role of discretion and contingency. One dissident scientist may be harassed persistently, whereas another is left alone; speaking out on one occasion may be greeted with tolerance or even praise, whereas on another occasion, it may trigger a serious attack. This variability can be attributed to psychological and organizational variables. Sometimes an official just happens to be aggravated, on a particular day, by a particular person or behavior, and this leads to an attack. To capture this variability, it is useful to say that a system of power provides resources for certain individuals to take certain types of actions—for example, for a laboratory manager to hire or fire a particular scientist. Thus, the system of power does not require suppression of dissent; it simply makes it possible. At the same time, psychology is not autonomous of power systems: certain belief systems and behavioral styles may thrive in suitable organizational and social structures and, in turn, either reinforce or challenge those structures (House 1988).

None of the controversies presented here provides a perfectly neat link between a discrete system of power and cases of suppression. The links are messy for at least two reasons. First, in these examples, the systems of power are not compartmentalized. Although particular chemical companies have a strong interest in pesticides, some government bodies are closely aligned to the industry. The dental profession may be the key driving force behind fluoridation, but some government and corporate bodies have strong interests in fluoridation as well. While state power is a key force behind the promotion of nuclear power, corporations are also

heavily involved, and many nuclear scientists and engineers have a career interest in the technology. These sorts of linkages are virtually inevitable.

A second complication in making links between systems of power and suppression in a certain field is that attacks often are made by the bosses of dissident scientists. For example, a common form of attack is for an industry or government official to call the boss of an outspoken scientist and suggest that action be taken. Sometimes there is no phone call at all: the boss, worried about keeping on the good side of industry or government, whether because of grants, employment prospects, or other considerations, takes action against a subordinate without any outside prompting. The action in this case serves the interest of industry or government without the necessity of overt intervention, but it can still make sense in such cases to speak of the influence of a system of power (see Crenson 1971; see also Lukes 1974).

The frequent examples of attacks by or through bosses provide an important insight into the exercise of power in science, namely, that hierarchy in science often tends to serve the interests of powerful outside groups. Hierarchy in science refers here to differences in power rather than knowledge (though these may be linked), and it is closely linked to the bureaucratic conditions in which most scientific research is carried out. Those scientists with the greatest say in decisions about research funding, research priorities, top-level appointments, and editorial policies can be called "political scientific elites" (Blissett 1972; Elias et al. 1982; Rahman 1972; Traweek 1988, pp. 126–156), but they have not been studied nearly as often as "cognitive scientific elites," namely, those scientists whose research productivity and intellectual stature give them great influence and status within science (Amick 1974; Merton 1973; Mulkay 1976; Polanyi 1951, p. 54; Zuckerman 1977), even though many political scientific elites are also cognitive elites.

A typical scientific career, as well as involving a long apprenticeship, often provides little security or scope for innovative or unorthodox research, especially in the early years. This encourages conformity to the directions set by scientific elites—directions that, in turn, are shaped by sources of funding and applications as well as career interests. Hierarchy within the scientific community thus is an advantage to powerful groups, although, of course, it does not guarantee that their interests will be served. The direct influence of bosses over scientists and scientific research is usually greatest within industry and government; within universities, professional norms and collegial interactions usually play a greater role, and it is no coincidence that for academics dissent is somewhat easier, though often still risky. While hierarchy within science facilitates attacks on dissidents, it can also facilitate links between interests and science in more routine ways, such as setting priorities for research. Although studies are available of the political machinations in and over science (Boffey 1975; Brickman et al. 1985; Dickson 1984; Greenberg 1967; Jasanoff 1990; Primack and von Hippel 1974), a thorough study of the rise of bureaucracy in science and the links between political scientific elites and other interests remains to be carried out.

To analyze the link between scientific bureaucracy and suppression of dissent, a convenient framework is the concept of bureaucracy as a political system (Weinstein 1977, 1979; see also R. Collins 1975, pp. 286-347; Perrucci et al. 1980; Zald and Berger 1978). Rather than treating bureaucracy as a rational administrative system, this approach draws an analogy with the state: bureaucracy is like an authoritarian state, except that usually, there is no capacity for physical violence. By extension, bureaucratic elites can be faced by opposition movements, coups d'état, and so forth. Whistleblowing—open individual dissent—is a special form of principled opposition. Suppression of dissent within a bureaucracy is analogous to government attacks on political opponents or movements—another area in which the role of contingent factors in the exercise of power against dissent is important. This conception of bureaucracy thus brings to the fore the phenomena of resistance to bureaucratic elites and suppression of dissent, but this model remains to be applied systematically to scientific research carried out in bureaucratic and semi-bureaucratic settings.

Social studies of science certainly provide more than adequate tools for dealing with suppression. There is a considerable literature showing how science can be understood as growing out of and shaped by the organization of society, including the state, capitalism, bureaucracy, the military, and patriarchy, and how these systems of power are linked to the internal power dynamics of science, involving elements including hierarchy, division of labor, professions, male domination, and cognitive authority. An approach along these lines (Abraham 1995; Blume 1974; R. Collins 1975, pp. 470–523; Restivo 1988, 1994; Sklair 1973) can be called a "political sociology of science" (Blume 1974). This sort of framework can be used to examine the development of particular research fields (Clark and Westrum 1987; Forman 1971; MacKenzie 1981; Wright 1994; Young 1973), to relate research to funding by state and industry (Clarke 1971; Noble 1977), to analyze the construction of boundaries within science and between science and nonscience (Gieryn 1983, 1995; Wallis 1979), to examine the relationship between major scandals in science and its social organization (R. Collins and Restivo 1983), and to determine the presence of bias in science-based regulatory decision making (Abraham 1993, 1994, 1995). So far, however, it has seldom been used to examine suppression of dissident scientists. One possible reason is that most analysts of science, whether positivist or constructivist, basically support science as it exists (Restivo 1988, 1994, p. 28).

COMPARATIVE STUDIES OF SUPPRESSION

The incidence and dynamics of suppression can vary according to many different factors and, hence, the study of suppression provides a window into the politics of expertise and legitimacy. The examples in this paper suggest the value of a field of study that could be called "comparative suppression studies": studying the

incidence and characteristic features of suppression in different fields, organizations, or polities, and relating this to social structure, interests, and other relevant factors. Here, several areas for comparative suppression studies are outlined: suppression in different countries and political systems; suppression of scientists versus suppression of nonscientists; suppression and social movements; and suppression and technical saliency.

One type of comparative suppression studies involves examination of the frequency and characteristics of suppression in different countries. For example, most documented cases of suppression of scientific opponents of fluoridation are from those few countries with a substantial level of fluoridation; in the case of nuclear power, which has been introduced in numerous countries, there are cases of suppression from around the world (Martin 1986). The available evidence, however, is too unsystematic to provide a basis for many conclusions. Yet, the obstacles to collecting comparative suppression evidence, which include language, culture, and organizational differences, are formidable. On the other hand, there is much to be learned from such studies, since insights about the effect of social structural and organizational variables are likely to be more obvious than with single-country studies.

It is also possible to compare methods of suppression used in different sorts of political systems and to examine the relative roles of repression and suppression (respectively, violent and nonviolent reprisals and deterrents). There is ample documentation of both repression and suppression of political dissidents in authoritarian regimes (see the journal *Index on Censorship* and reports produced by Amnesty International); there is also much information on suppression (and some repression) of political and other dissent in liberal democracies (Arblaster 1974; Belfrage 1973; Blackstock 1976; Bunyan 1976; Caute 1978; Cowan et al. 1974; Donner 1980; Fitzgerald 1972; Gelbspan 1991; Goldstein 1978; Halperin et al. 1976; Harris 1976; Hillyard and Percy-Smith 1988; Hollingsworth and Norton-Taylor 1988; Parenti 1971; Schultz and Schultz 1989; Wolfe 1973). But there is relatively little comparative analysis of suppression and repression under different political systems, much less of suppression in science.

Another comparative dimension involves differences between scientists and nonscientists. There are many documented cases of workers or community activists, without credentials or special status, who have opposed pesticides, fluoridation, or nuclear power and have come under attack (Cutler 1989; Day 1989; L. Freeman 1981; Peterzell 1980; Shoecraft 1971; Van Strum 1983). The limited information available seems to suggest that the characteristic methods used to attack nonscientists are different, in part, from those used to attack scientists, no doubt because techniques such as withdrawing grants can seldom be used against nonscientists. For example, in liberal democracies, physical violence against dissident scientists seems less common than violence against dissident nonscientists. A comparative study of the suppression of scientists and nonscientists could yield insights into the exercise of power in science.

One of the most promising types of comparative suppression studies involves looking at different fields or issues. For example, there is ample evidence of suppression in the areas of pesticides, fluoridation, and nuclear power but, for example, few publicized cases of suppression associated with the automobile industry (McCarry 1972; Otake 1982). There are at least two reasonable hypotheses worth exploring. One is that suppression is more common and visible when a social movement makes a challenge to a powerful interest group that has a near-monopoly on scientific credibility. The existence of a social movement makes technical dissent more threatening, since it can be used to give the movement greater credibility. Additionally, the existence of a movement provides a receptive audience—both among movement supporters and among the general public—for scientific work or statements challenging orthodoxy, thus potentially encouraging critics to speak out. Thus, there are likely to be more cases of critics who speak out and more incentive to suppress those who do. This dynamic could explain the difference in the incidence or visibility of suppression in different fields. There has been major citizen action against pesticides, fluoridation, and nuclear power, but nothing comparable in the way of an "anti-car movement."

An alternative or complementary hypothesis is that suppression is more common in areas where technical expertise is more crucial to the power of an interest group. Many fields involve technical issues and actual or potential technical disputes, but only in some are the technical issues of truly central importance. In disputes over nuclear power, for example, the major arguments have focused on health and the environment, involving concerns such as reactor accidents and radioactive waste, and have involved technical claims and counterclaims. Compare this to the automobile industry, where the technology is more familiar and where expertise is less monopolized by the industry. It might be, then, that in the case of automobiles, technical criticisms are less salient, both to critics and to the industry itself. Another comparison is between the debates over nuclear power and nuclear weapons. In both cases, there have been significant social movements, but there seems to be more evidence of suppression of scientists who are critics of nuclear power than of those who are critics of nuclear weapons. This could be because technical disputes are more central to legitimacy in the nuclear power issue, whereas moral and military considerations have played a much more prominent role with the nuclear weapons debate, although that latter debate has also involved a series of technical disputes, from the hazards of fallout to the accuracy of missiles.

An insight into the centrality of technical issues is given by the rhetoric used in controversies. Freudenburg and Gramling (1994) note that attacks on critics are an important aspect of what they call "diversionary reframing," in part because the attacks serve to divert attention away from the criticism itself, by reframing the debate as being "about" the legitimacy of the critics. The nature of the attacks, however, may well be telling. In the pesticide, fluoridation, and nuclear power debates, opponents have often been castigated as uninformed (scientifically), unscientific, and even antiscientific. In the case of the automobile industry, critics

are more likely to be treated as threats to economic prosperity or, in its equivalent in the U.S. context, as "unAmerican." In the debate over nuclear weapons, critics in the west have been called ignorant of the realities of world politics or, until the 1990s, communists or traitors.

More investigation is required to determine whether these or other hypotheses can be sustained. Before that can occur, though, there is a need for systematic studies of technical dissent within the automobile industry, within the nuclear weapons establishment, and in any other area with which comparisons might be made. But as well as more evidence, there is also a need to deal more systematically with methodological issues in suppression studies, such as criteria for assessing alleged instances of suppression and ways for going beyond publicized cases to those that are hushed up. Studying suppression has the potential to reveal much about the dynamics of expertise, power, and legitimacy in contemporary society, but this type of investigation is bound to remain controversial itself, both because of definitional and methodological challenges and because it draws attention to an exercise of power that those exercising it would prefer to pass unnoticed.

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