

### • ABSTRACT

*The fluoridation issue provides a test of some of the usual approaches to the analysis of scientific controversies. One of the important features of the fluoridation debate has been the use of professional power to promote fluoridation and to attack the credibility and activities of anti-fluoridation scientists. To incorporate this feature, the 'resources' perspective must be broadened to include resources besides discourse. Even so, the resources perspective cannot touch certain key questions, such as why fluoridation was so heavily promoted originally. For this, a structural analysis is useful, though it needs to be extended to include more scope for human agency.*

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## Analyzing the Fluoridation Controversy: Resources and Structures

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**The fluoridation of public water supplies** as a measure to prevent tooth decay has been one of the most persistent and hotly contested public health controversies over the past several decades. While support for fluoridation remains overwhelmingly the orthodox view in the dental, medical and scientific communities,<sup>1</sup> substantial public opposition continues, supported by a minority of scientists.<sup>2</sup>

Such a controversial issue seemed bound to draw the attention of social scientists, and indeed there have been literally hundreds of studies. Most of these have been carried out in the United States, dealing with the issue there. The greatest attention was in the 1950s and 1960s; since then the social science of fluoridation has languished. The development of the sociology of scientific knowledge since the 1970s provides tools for a re-examination of the fluoridation controversy. At the same time, a re-examination of the controversy provides material for testing and extending the social analysis of controversies.

The bulk of the social science literature on fluoridation has assumed,

implicitly or explicitly, that fluoridation is scientifically proven and indeed scientifically unquestionable. The many studies that fall into this category make no examination of the scientific evidence, but rely entirely on the endorsements of dental and medical authorities. With a positivist view of knowledge, the result is a virtually exclusive focus on opposition to fluoridation: it is the existence and persistence of this opposition which has to be explained.<sup>3</sup>

One strand of explanation has concerned demographic correlations with people's views and votes on fluoridation, with attempts (for example) to link opposition with low education, low income, political conservatism, lack of children or old age.<sup>4</sup> Another popular and closely related explanation was 'alienation': opponents were seen as alienated from the dominant culture and using opposition to fluoridation as a means to vent their frustrations.<sup>5</sup> A third explanation was that voters became confused during referenda campaigns, and took the 'safe' route of opposing fluoridation.<sup>6</sup> In each case the explanations are unflattering to opponents. Fluoridation is assumed to be rational and progressive.

These studies face several difficulties, many of them stemming from their uncritical conception of scientific knowledge. Many of the findings in the demographic and alienation studies have not stood up to further examination.<sup>7</sup> More importantly, none of these explanations account for the lack of fluoridation in Europe,<sup>8</sup> where public involvement has been much less, and the key decisions have been made administratively. Finally, the asymmetry of the explanations means that no sociological examination has been made of the promotion of fluoridation.

There are a number of studies which examine the macroscopic politics or sociology of fluoridation controversies, mainly at local or province levels.<sup>9</sup> These studies, which use orthodox tools of political science and sociology, can illuminate the dynamics of political struggle and group dynamics, but seldom delve into the exercise of power within the scientific, medical and dental communities.

One of the very few studies to treat the two sides symmetrically is Mazur's highly cited 1973 paper 'Disputes between Experts', later incorporated into his book *The Dynamics of Technical Controversy*.<sup>10</sup> Mazur accepts that there is actually a scientific controversy involved over fluoridation, and analyzes the scientific disagreements over fluoridation and nuclear power (mainly low-level ionizing radiation). He discusses a number of features of the disputes, including rhetorical devices used by scientists, interpretation of ambiguities and rejection of discrepant data. Significantly, Mazur's paper is only rarely cited in the other (positivist) social science literature on fluoridation. While providing

valuable insight into the means by which disagreements between experts are perpetuated, and the way in which scientific arguments are used as resources in a struggle over public policy, Mazur's treatment does not delve into the exercise of power in the relevant professional communities, nor into the social forces behind the promotion of fluoridation.<sup>11</sup>

In this paper, I will analyze the fluoridation controversy using two contrasting and complementary approaches. First, I use the concept of 'resources' and other concepts from the sociology of scientific knowledge to examine the struggle for scientific authority. Instead of focusing exclusively on claims and rhetoric about knowledge and authority as resources, other things need to be included — especially professional power. The second approach used to examine the controversy is structural analysis, which in this case draws attention to the role of corporations in structuring the social space in which the promotion of fluoridation has taken place. In the concluding section, I discuss a number of approaches to controversies, and the insights concerning them which are provided by this analysis of the fluoridation issue.

## **The Fluoridation Issue and the Resources Approach**

Water fluoridation is the addition of the element fluorine, in its ionic form called 'fluoride', into public water supplies in order to reduce the incidence of tooth decay (dental caries) in children. The concentration of fluoride considered optimal for this is about one part per million, more or less depending on the climate (in hotter temperatures people drink more water and the required concentration of fluoride is lower). The idea of water fluoridation arose following the search in the first few decades of this century for the cause of mottled enamel (dental fluorosis), which is prevalent in various communities around the world. The causative factor was finally traced to naturally high fluoride levels in local water supplies.<sup>12</sup> People in these areas also seemed to have less tooth decay, thus giving rise to the proposal to add fluoride to other water supplies. Also important were studies of the effects of fluoride on the teeth of animals.

After advocacy of fluoridation in the United States, several trials were begun, the first in 1945, in which one community's water supply was fluoridated and another's, serving as a control, was not. At the time, there was considerable scepticism among public health professionals about the advisability of fluoridation, and a number of figures advocated caution until the outcome of the trials, expected to last 10 or 15 years.

But in 1950, the United States Public Health Service made an endorsement of fluoridation, and this was quickly followed by favourable statements from the American Dental Association and the American Medical Association. This led to a large expansion in the number of fluoridation programmes in the United States, and then in some other countries.

In spite of the overwhelming endorsement by dental and medical bodies, by the mid-1950s a surprising opposition to fluoridation in towns and cities around the United States had arisen.<sup>13</sup> The opponents alleged that fluoridation did not lead to the massive reduction in tooth decay claimed by proponents, and said that various health problems could be attributed to fluoridation, including chronic fluoride poisoning, allergic reactions and Down's Syndrome. A crucial argument concerned individual rights — namely, that people should not be given medication against their will.

Fluoridation has mainly been taken up in English-speaking countries, and the pattern of support and opposition has remained much the same over more than three decades. Endorsement of the measure has been made by most established public health, dental and medical bodies, while concerted opposition has been organized by voluntary citizen groups, supported by a few relevant professionals. Elsewhere in the world there is relatively little fluoridation; in particular, the level of fluoridation in Europe is very low.<sup>14</sup> Especially in English-speaking countries, debates over fluoridation have been among the most bitter public issues in local communities, with intense mobilization of public feeling. Brought into the fray have been dentists and doctors, politicians, local government officials, service clubs, water boards, trade unions, the mass media and numerous volunteer citizen groups. When administrative bodies have made decisions about fluoridation, the tendency has been to implement it. The majority of referenda, on the other hand, have opposed fluoridation.<sup>15</sup>

The contemporary sociology of scientific knowledge has been used extensively to analyze scientific controversies, using the concept of 'resource'.<sup>16</sup> Various things are brought into the fray as resources or tools, including assumptions and claims about knowledge and authority, methodologies, and control over publication, research grants and appointments. For example, rhetorical devices are used as resources in conversations between scientists in laboratories to persuade each other, and, in scientific papers, to enrol others in a particular viewpoint. The controversy over fluoridation can be readily analyzed using the concept of 'resource'. Rhetorical resources are used routinely in the debate. Mazur has illustrated many of the devices used in the technical side of the

debate.<sup>17</sup> In campaigning, each side uses words and phrases with the best possible connotation. For example, proponents refer to 'controlled fluoridation' (because the concentration of fluoride in the water is controlled within limits) whereas opponents use the phrase 'artificial fluoridation' — in each case drawing on wider connotations of the words 'controlled' and 'artificial'. Proponents refer to 'water deficient in fluoride' whereas opponents refer to 'mass medication'. Such rhetoric is not simply used, but is actively promoted by organizations — for example, by the American Dental Association in advice to 'citizens committees' pushing for fluoridation.<sup>18</sup>

As well as argument and suggestive language, another important resource in the debate has been scientific authority. Many dentists, doctors and citizens do not examine the scientific and ethical issues in any detail, but instead rely on the views of people or organizations they trust. Because professional bodies have routinely endorsed fluoridation since the 1950s, the resource of authority has been almost entirely in the hands of the pro-fluoridationists. Proponents have claimed that science provides support for fluoridation and, going beyond this, that there is no scientific debate.<sup>19</sup> Opponents are categorized as rejecting rational policy,<sup>20</sup> and acting on the basis of political motives.

The concepts of constitutive (or empiricist) and contingent repertoires are relevant here.<sup>21</sup> The proponents attribute their stand to science, using the constitutive repertoire, while attributing opposition to personal or political factors, using the contingent repertoire. The opposition, on the other hand, explains promotion of fluoridation in contingent terms — professional vested interests, corporate profits — while claiming scientific backing for its own stand.<sup>22</sup> But the two sides are not symmetrical in their appeals to science to support themselves and appeals to non-scientific factors to explain the opposition. Anti-fluoridationists, because they do not have the resource of authoritative endorsement, are much more likely to argue that values and interests are involved in the issue, especially individual rights which they say are violated by compulsory medication. Thus the possession or non-possession of the resource of authority has influenced the repertoire used by each side.

The resource of authority has not always been in the hands of the pro-fluoridationists. Before fluoridation was introduced, a cautious go-slow attitude was the predominant one in scientific circles in the United States. In this situation, a small number of vociferous advocates for fluoridation lobbied strenuously (especially the Wisconsin dentists John G. Frisch and Francis A. Bull), resulting eventually in the US Public Health Service announcement in 1950:

As the gadflies of the profession, the Wisconsin advocates of mass fluoridation soon gained a reputation among their professional colleagues. They never lessened the intensity of their attack. They knew the value and the methods of political procedure and stubbornly maintained a steady pressure on their professional enemies. Outspoken and at times harsh and unbending, the dedicated little group helped create the atmosphere for the significant change in policy.<sup>23</sup>

Prior to the major endorsements, the pro-fluoridationists were constantly questioning the scientific basis of those who were more cautious about fluoridation ('their professional enemies'), for example by pointing to the 'proof' provided by naturally fluoridated waters. The proponents were openly political in their struggle. But this changed dramatically in the 1950s, after the key public health and professional bodies came out supporting fluoridation. Almost overnight, the scientific issues were treated as closed. Fluoridation was considered scientifically proved and, furthermore, criticisms of fluoridation were treated as political rather than scientific. Opponents were classified as cranks rather than as rational critics.

This change in style and tactics by pro-fluoridationists is quite compatible with the resources perspective. While in a minority position, without official endorsements, the pro-fluoridationists used claims about scientific knowledge as one lever to promote their cause. But once authoritative bodies had decided to support fluoridation, it became advantageous to deny opponents the lever of disagreements about scientific knowledge. Since the 1950s, it has been the anti-fluoridationists who have been more openly political in their campaigning. This switch correlates directly with the weight of authoritative endorsement. The 'endorsed' group prefers to avoid or deny scientific dispute and rely on authority, while the challenging group highlights the existence of scientific disagreement and argues for examination of the evidence.<sup>24</sup>

The asymmetry in the resource of authoritative endorsement is shown by the frequent refusal by pro-fluoridationists to debate openly with anti-fluoridationists.<sup>25</sup> Refusing to debate can be interpreted as an attempt by those with a near monopoly over scientific credibility to deny any of this credibility to the opponents. Not only has refusal to debate been common in local fluoridation controversies — for example, before referenda or administrative decisions — but it has also been recommended by social scientists who have analyzed the issue, and who have assumed that their goal is to help promote fluoridation.<sup>26</sup>

Refusal to debate can raise problems, at least in certain polities. When a referendum is to be held and supporters of fluoridation refuse an open invitation to debate, this is often seen by electors as arrogant. As analyzed

by Raulet in one of the few treatments of proponents of fluoridation,<sup>27</sup> professionals such as dentists and physicians promoting fluoridation can take either the role of experts or partisans. As experts, they use the resource of authority, but are open to the charge of arrogance in refusing to debate. But if they enter the debate as partisans, the role of expert knowledge in support of fluoridation is undercut. The result is that those in control of the resource of certified expertise prefer to define the issue as non-political, resulting in a strategy by opponents in promoting debate, raising issues in the contingent repertoire and generally challenging the wall of professional expertise. The stance taken by many promoters of fluoridation is that the measure is beyond question scientifically, but that a concerted political struggle must be waged to order to obtain it.<sup>28</sup> This view contains no contradictions within the usual picture, in which fluoridation is assumed to be scientifically proven; the difficulties arise in political practice.

Refusal to debate is most effective when the full weight of scientific credibility is on one side. Even a few dissenting scientists, if they are willing to speak out, challenge the claimed monopoly over scientific knowledge; such dissenting scientists therefore have a political impact much larger than is suggested by their isolated position.<sup>29</sup> Anti-fluoridationist groups have scoured the dental and medical literature in search of studies and comments supporting their stand.<sup>30</sup> Those few scientists who have openly criticized aspects of fluoridation usually become widely taken up as full-fledged opponents. This is what is to be expected, given the importance of the endorsement of scientific knowledge in the fluoridation dispute.<sup>31</sup>

How have proponents of fluoridation responded to the scientist critics? Their responses have varied according to the individual and the situation, but there is sufficient evidence available to argue that control over the resources linked to endorsement by professional bodies has regularly been used to discredit and discourage opponents, even when doing this conspicuously violates commonly voiced norms about professional behaviour. Starting with rhetoric as a resource and moving to authority as a resource, the issue now is professional power as a resource.

Discrediting opponents by challenging their motivations, the relevance of their credentials, their affiliations, their scientific bona fides or their personal backgrounds has been a regular feature of the fluoridation controversy. On an informal, person-to-person basis this sort of discrediting goes on all the time, and is used by opponents as well as proponents of fluoridation against the other side.<sup>32</sup> But because the proponents have the backing of professional organizations, their efforts in this have been backed by the financial and other resources of these

organizations. The nature of the attacks is vividly shown in a document entitled 'Comments on the Opponents of Fluoridation', which was circulated by the American Dental Association in the 1960s and twice published in their journal. The opening commentary states,

The following pages contain excerpts from material concerning some of the individuals, organizations and publications opposed to the fluoridation of community water supplies. This material has been compiled for the general information of members of the dental profession and others interested in this public health measure. . . . This article has only one purpose: to furnish information on the background, qualifications and activities of the best known opponents of fluoridation for use by those persons or groups contemplating, planning or engaged in a fluoridation effort on a one-time or continuing basis.<sup>33</sup>

The article contains material on individuals (such as scientists Frederick B. Exner and George L. Waldbott) and on groups (such as the American Academy of Nutrition and the Ku Klux Klan). The material consists entirely of quotes, taken from newspapers, letters, journal articles and books, which are mostly critical or derogatory about the individuals and groups concerned. There is comment about some groups' anti-semitic stands, about their views on other issues such as vaccination, and about the background of individuals (which include being an escapee from a mental hospital, and being convicted for unlawfully practising medicine).

Information in this dossier has been widely used against opponents of fluoridation. For example, after it was produced, the allegations about Waldbott, probably the foremost scientist opponent of fluoridation in the United States from the mid-1950s until the mid-1970s, followed him wherever he went.<sup>34</sup> By categorizing otherwise respectable scientists (such as Exner and Waldbott) with a variety of extremist groups (such as the John Birch Society), and by including all sorts of attacks and criticisms without any context or commentary, the result is that this material is used to damn the individuals and groups named, rather than to deal with the issues they raise. By providing the professional stamp of approval for use of this sort of material, the American Dental Association used its authority, in effect, to encourage the relegation of all opponents of fluoridation to the category of political extremists, health quacks, and unqualified or tainted individuals. This can be considered to be an example of the professional promotion of the contingent repertoire as the main arena for responding to critics.<sup>35</sup>

Many anti-fluoridationists have made just as serious attacks on proponents of fluoridation — and indeed some outrageous denunciations — but these attacks have less credibility among most 'opinion leaders' and



policy-makers because they are not backed by the relevant professional body. The point here is not just that pro-fluoridationists have used the contingent repertoire, as have anti-fluoridationists, but that they have been backed in this by the resource of professional endorsement and support.

Waldbott's successor as the most prominent scientist opponent of fluoridation in the United States is John Yiamouyiannis, who is best known for his claims about a link between fluoridation and cancer death rates. Major attacks have been made not only on Yiamouyiannis' scientific work but also on his credentials, motivations and affiliations. In particular, an article in 1978 in the consumer magazine *Consumer Reports* attacked Yiamouyiannis, for example by claiming that the National Health Federation, which employed Yiamouyiannis at the time, had been shown by the Food and Drugs Administration to be 'a front for promoters of unproved remedies, eccentric theories and quackery'.<sup>36</sup> Yiamouyiannis has denied the relevance of this material on the grounds that it is guilt by association,<sup>37</sup> but the attacks on Yiamouyiannis and the National Health Federation have wide currency because of their circulation via dental associations.<sup>38</sup> Once again, professional dissemination and endorsement plays a major role in the effectiveness of rhetorical resources.

Verbal attacks, backed by a professional body or not, are one thing. But more serious are threats and actions which potentially jeopardize the careers of opponents. There are sufficient instances of this sort of action to suggest that it has played a significant role in the debate. Here I present a selection of cases before commenting on their status and meaning as evidence.

- Waldbott has described the professional disincentives for dentists and doctors in the United States towards speaking out against fluoridation. He says that while many presidents or secretaries of dental or medical societies will privately express concern about fluoridation, to do so openly would mean the end of their careers in these societies.<sup>39</sup>

- In the 1950s, 'One internist, still practicing in Detroit, received a warning from a member of his hospital staff. Should he continue to publicly oppose fluoridation he would jeopardize his consultant practice, even his hospital staff appointment. He was profoundly distressed. Reluctantly he withdrew. He had no other choice.'<sup>40</sup>

- A doctor who recommended to a patient to stop drinking fluoridated water in order to overcome a stomach ailment asked the patient to refrain from revealing his diagnosis to anyone so that it would not jeopardize his position in the eyes of colleagues, especially the medical officer for health.<sup>41</sup>

- A sociology student carried out a survey of a medical society and found that only half of the respondents favoured fluoridation, while a third opposed it. 'The assistant

dean, prompted by the fluoridation chairman, wrote a letter berating the student for allegedly abusing the good name of her school.' Although threat of a legal action by the student forced a retraction of the letter's allegations, the attack discouraged the student, a physician's wife, from publishing her data.<sup>42</sup>

- Waldbott argues that the United States Public Health Service has actively discouraged critical research on fluoride.<sup>43</sup> As a major granting body with influence in medical and dental circles throughout the country, 'Its officials can make or break a scientist'.<sup>44</sup> 'Those who have produced research with results unfavorable to fluoridation, hesitate to appear as witnesses [at court cases concerning fluoridation] because of threat of reprisals, especially if they are connected with a university'.<sup>45</sup>

- Waldbott also describes a case of misrepresentation in 1965, in which prominent pro-fluoridationists presented themselves as anti-fluoridationists to a woman whose doctor had advised her to avoid fluoridated water in order to overcome health problems. After revealing the name of her physician, five pro-fluoridationists visited him. 'After their visit he had no choice but to remain silent'.<sup>46</sup>

- In the 1970s, Carol Farkas, a Canadian researcher who has studied the levels of fluoride in foods, gave a talk on this subject to the Canadian Dental Association's annual meeting. After the talk, several dentists came forward, asked for her phone number and said they would call. Five of them did so, 'saying they agreed with what I had said but couldn't say so in public because they could get black-balled from the CDA'.<sup>47</sup>

- Dr R. J. Berry of Oxford, who in 1963 published results of research showing a reduction in the rate of growth of cancer cells in the presence of 0.1ppm of fluoride, decided to abandon further work on fluoride after being criticized and subjected to 'veiled threats'.<sup>48</sup>

- A conference on the toxicology of fluorine, planned to be held in Holland, had to be transferred to Bern because of opposition from Dutch dental interests. Attempts were made to suppress publication of proceedings of the conference; one publisher dropped the book after completing all the typesetting.<sup>49</sup>

- John Polya, associate professor of chemistry at the University of Tasmania, was an outspoken critic of fluoridation. He claimed in 1973 that his staff and equipment had been taken away because of his stance on the issue.<sup>50</sup>

- In 1979, Geoffrey Smith, a dentist, worked at Proserpine Hospital in Queensland, and supervised a dental therapist at a local primary school. He drew attention to the high level of dental fluorosis in children there, and began collecting data on this and on dietary sources of fluoride. He claims he was officially warned to cease the research and, after media coverage elsewhere in the country, was fired.<sup>51</sup>

- In the 1980s, Mark Diesendorf has been one of the most prominent scientist opponents of fluoridation in Australia. Until 1985, he worked as a Principal Research Scientist at the Commonwealth Scientific and Industrial Research Organization (CSIRO). Officials of the Australian Dental Association have written letters to the chairman of CSIRO and to the federal Minister for Science and Technology (responsible for CSIRO) complaining, for example, that Diesendorf had 'mis-used his CSIRO connections to lend weight to his views on subjects outside his expertise', and requesting the taking of 'all necessary steps to ensure this deceptive practice does not continue'. Although CSIRO defended Diesendorf in correspondence on the grounds that he had made clear that he spoke about fluoridation in his 'private capacity', the letters show clearly the importance fluoridation promoters place in attacking any opponents who have the status of scientist.<sup>52</sup>

There are many other allegations in the literature of this sort — for example, that proponents of fluoridation have ‘neutralized’ research findings by circulation of unpublished criticisms, given wide publicity to tendentious attacks on opponents, dismissed critics from positions at universities, hospitals and corporations, suspended dentists from dental societies and misrepresented themselves as anti-fluoridationists.<sup>53</sup> The combination of direct attacks on some public opponents of fluoridation, fears about loss of grants and the general labelling of opponents as ignorant and misguided combine to discourage many scientists from doing research or speaking out on the issues. The relative lack of open opposition in turn encourages a perception of the fringe nature of critics.

Although there is considerable evidence of attacks on critics of fluoridation, it is far from a ubiquitous phenomenon. For example, the Secretary of the National Pure Water Association is not aware of any pressure brought to bear against scientists critical of fluoridation in the United Kingdom.<sup>54</sup> A difference from the United States in this regard may perhaps be explained by the much lower level of fluoridation in the UK (less than 10%), and the much smaller role of scientific research funding from industry and public health bodies.

The direct attacks that occur, plus fears of jeopardizing careers, help to ensure that relatively few articles critical of fluoridation are ever submitted to scholarly journals. Of those that are, there is some evidence that it is more than usually difficult to obtain publication.

- Mark Diesendorf submitted an article critical of fluoridation to the Australian journal, *New Doctor*. It was rejected because ‘it might encourage the antifluoridationists’. The editor did not supply the referee’s comments, and would not even write in a letter that the article was rejected, only offering this information over the telephone.<sup>55</sup>

- In a court hearing, Waldbott was asked ‘How did it happen that the *Journal of the American Medical Association*, the *Annals of Internal Medicine*, the *Journal of Gerontology*, and *Annals of Allergy* turned down your articles on fluoride poisoning?’ Since the question enumerated ‘every single journal that had ever rejected an article of mine’, Waldbott inferred that Public Health Service officials, as editorial consultants, must have advised the editors of these journals to turn down the articles, and that the editors had provided the information that they had done so.<sup>56</sup>

- Albert Schatz — often noted as the co-discoverer of streptomycin — in the 1960s sent three separate letters to the editor of the *Journal of the American Dental Association*. Apparently because Schatz was a known critic of fluoridation, all three certified letters were refused and returned to Schatz unopened.<sup>57</sup>

What is the status of these cases as evidence? The accounts come almost entirely from opponents of fluoridation (though anyone who presents one of these cases is likely to be, by that action, classed as an opponent).

These cases are presented by opponents because they seem to show that the proponents are not acting as scientists, according to scholarly proprieties. Although some of the cases leave room for interpretation, in quite a number the basic events seem unlikely to be disputed: certain dentists, for example, have been suspended from their dental associations as a direct result of their publicly expressed opposition to fluoridation. In other words, the accounts are not fictional (to a positivist). What is open to dispute is the interpretation placed on these events.

Some would claim that this sort of 'dirty dealing' happens on both sides of the debate. But to my knowledge, there are no accounts of blockage of funds, denial of publication or suspension from dental associations instigated by anti-fluoridationists against proponents. This asymmetry is easily explained: the opponents simply do not have the control over the professional resources required to do these sorts of things.

From the point of view of the sociology of scientific knowledge, these examples show that the fluoridation debate has been much more than an epistemological dispute: more powerful resources than claims to knowledge have been brought to bear. In particular, the pro-fluoridationists, through their control over dental and medical associations, their control over health authorities, and their influence over editorial policy of journals and publishers, have exerted power to stop the expression of anti-fluoridation views by professionals.

Whether this sort of behaviour is justifiable is another question. To positivists, justifications are crucial in evaluating behaviour; to relativists, any justifications are themselves resources. Though the supporters of fluoridation seldom mention these cases, they would probably claim that there are very good scientific or professional reasons for steps taken against opponents of fluoridation. In such claims, the resource of a near-monopoly of scientific and professional authority is used to justify behaviour. Opponents of fluoridation raise these cases of 'suppression' as showing the political rather than the scientific basis for the promotion of fluoridation — or, in other words, the contingent as opposed to the empiricist factors. By highlighting discrepancies between the stated norms of scientific behaviour and the actual behaviour of certain scientists, the opponents use the category of 'unjustifiable behaviour' as a resource in their struggle.

Another way to look at the attacks on opponents is as a form of 'boundary work' done by scientists in an attempt to demarcate their activities from non-science. In Gieryn's analysis, 'boundary work' is work using rhetoric.<sup>58</sup> It is easy to expand the concept to include the use

of professional power to attempt to ensure that all anti-fluoridationists are considered not to be scientists.

### **Structural Analysis of the Promotion of Fluoridation**

A traditional form of social analysis is built around examination of social structures or social institutions such as the state, capitalism, racism and patriarchy. Class analysis along Marxian lines is a prominent example. A structural analysis of a controversy typically will involve examination of structures associated with one or both sides of the dispute and the dynamics of struggle, as in the case of the capitalist ownership of the means of production versus challenges by workers and socialist parties, which is part of the dynamic of class struggle. Social structures are often treated as if they exist independently of the individuals and groups who take actions within them, or whose actions constitute the structures. The structures, such as class or gender, serve as analytical categories.

Here I make a structural analysis of the promotion of fluoridation. The promotion of fluoridation provides much more scope for the application of structural analysis than does the opposition, because there are few obvious links between the opposition and major social structures.<sup>59</sup>

The analysis begins with corporate interests in fluoridation.<sup>60</sup> Fluoride is a major industrial pollutant, especially for the aluminium industry. Releases of fluoride, for example, have been opposed by farmers because of their detrimental effects on crops and animals. Fluoridation provides a profitable outlet for some of the fluoride waste from industry. A simplistic analysis of the promotion of fluoridation, often found in the anti-fluoridation literature, sees these profits as a key driving force behind the measure. But any financial returns from selling fluoride are far outweighed by symbolic benefits.

The pressures for regulation of fluoride emissions and of fluoride-related industrial processes partly reflect public perceptions of the hazards. If the public perceives fluoride as a dangerous chemical, then pressures are likely to be great. But if a benign image of fluoride can be established, this problem for industry is lessened. The promotion of water fluoridation as a public health measure has served this purpose admirably.

The material and symbolic advantages to industry of fluoridation could be considered fortuitous, but anti-fluoridationists point to evidence of a much more active role by particular corporations in the promotion of fluoridation. In the 1930s and 1940s in the United States, aluminium

and other industrial companies funded research into fluoride, as indeed they continue to. It was Gerald Cox, a biochemist employed by the Mellon Institute (founded by the Mellons, former owners of the Aluminium Company of America, Alcoa), who in 1939 had the original idea of adding fluoride to water supplies in an attempt to replicate the effects of naturally fluoridated water on teeth. Cox was a key promoter of fluoridation. He was aided by Oscar Ewing, a lawyer who was put on the payroll of Alcoa in 1944 on a huge salary. Shortly thereafter, Ewing left Alcoa to head the Federal Security Agency, whose jurisdiction included the US Public Health Service. It was the USPHS whose endorsement of fluoridation in 1950, and heavy promotion of it thereafter, did more than anything else to legitimate the measure.<sup>61</sup>

Proponents of fluoridation have responded to this argument by noting that the connection between Ewing as lawyer for Alcoa and as a key figure in the USPHS is irrelevant, because Alcoa does not manufacture sodium fluoride which is used for water fluoridation — and, in any case, the amounts used are small compared to the fluoride wastes created in aluminium production.<sup>62</sup> This response shows the weakness of the argument that fluoridation provides significant material (physical and financial) benefits to industry. But it in no way addresses the issue of symbolic advantages to industry, which can result in material benefits via a reduction in law suits and a reduction in political pressure for regulation of fluoride-producing industrial processes.

Great symbolic benefits also accrue to the manufacturers of processed carbohydrates, especially sugar and sugary foods. Sugar is widely recognized by experts, and perceived by the public, as a cause of tooth decay. If sugar is seen as the primary cause of tooth decay, then pressures to reduce sugar consumption are to be expected. But fluoride as a preventive undercuts the emphasis on sugar. Tooth decay is then attributed to a lack of fluoride, to drinking 'fluoride-deficient' waters.

There are many connections between sugary food manufacturers and the promotion of fluoridation. The Sugar Research Foundation in the United States, set up in 1943, has provided considerable research funding for fluoridation. The Foundation's 1950 annual report stated its aim in dental research as: 'To discover effective means of controlling tooth decay by methods other than restricting carbohydrate [sugar] intake'.<sup>63</sup> Some of the prominent promoters of fluoridation, such as Frederick Stare of the Department of Nutrition at Harvard University and Elsdon Storey of the School of Dentistry at the University of Melbourne, have worked with organizations in receipt of major research funding from the sugar industry.

In Australia, the links between industry and fluoridation are epitomized by the Dental Health Education and Research Foundation, which was set up in 1962. Donors and members of DHERF include manufacturers of sugary foods and fluoride toothpastes. DHERF has devoted a considerable portion of its efforts to the promotion of fluoridation. A body like DHERF is useful to companies which want to encourage the promotion of fluoridation, but not be too conspicuous about it.<sup>64</sup>

The industrial interest is a possible explanation of the promotion of fluoridation, but the evidence shows that the major push has come from dental and, to a lesser extent, medical professionals: especially dental researchers, dental workers in government health authorities, and some dentists and doctors. Industry has taken a low profile after the early years, and dental professionals have been the primary promoters. This raises two questions. Why have certain members of the dental and medical professions so ardently supported fluoridation? Given that dental and medical professionals have been the prime promoters of fluoridation, what then is the causal role of the industrial interest in fluoridation? For each question there are a multitude of possible answers, and the body of social research necessary to answer them confidently is not available. Here I will outline one plausible explanation.

Any explanation should account for several apparently puzzling observations. First, why should dentists eagerly promote a measure which seems to remove a major prop to their economic existence? Second, why has fluoridation been implemented more in English-speaking countries than in Europe, contrary to the finding in the social studies of fluoridation which shows that fluoridation is more likely to be implemented in communities where decisions are made administratively rather than with community participation?<sup>65</sup>

The traditional perspective on professions sees them as groups of specialists who, because of the social importance of their skills, have developed mechanisms for training, self-regulation and social responsibility. According to this perspective, the promotion of fluoridation would be an example of professional altruism, a result of professionals' commitment to serving the community. This view has been challenged by the 'power theory of professions', according to which professions are simply occupational groups which have garnered resources, privileges and status by monopolizing certain skills and legitimating this process through the ideology of professional status. Related to this is the concept of 'professional dominance', in which certain occupational groups maintain power over others using resources of certification (usually guaranteed by the state), control over knowledge and the division of labour. The

relationship between physicians and nurses is a typical one of professional dominance.<sup>66</sup> This approach to professionals provides a direct explanation of the 'suppression of opponents'.<sup>67</sup>

The promotion of fluoridation has mainly been carried out by a tiny fraction of dental and medical professionals. Some of these, especially researchers into fluoride and tooth decay, have built their reputations on work tied to the promotion of fluoridation. 'Altruism' at the material level does not apply here. Many others, active in campaigning for fluoridation, develop a personal stake in the issue: their public images and self-images are tied to the benefits of the measure. So while we may assume that virtually every individual will have and profess altruistic motives, there are plausible material and psychological reasons for leading proponents to support, or continue supporting, fluoridation.

In any case, the reduction of tooth decay has not in practice had such a devastating impact on the career prospects for dentists as might be imagined. There is plenty of other work, such as treating gum disease, orthodontics and restorative dentistry.<sup>68</sup> Besides, the number of dentists has never been large enough to cater for all the people requiring dental treatment. Reductions in tooth decay have changed the nature of the practice, not its viability. Finally, dental élites control to some extent the number of new entrants into the field by their influence over intakes into dental courses. In Australia, certainly, only a tiny fraction of university entrants have test scores sufficient to enter dental school, due to a restricted intake and attractive career prospects rather than the intrinsic difficulty of becoming a competent dentist.

This analysis of dentistry is no different from the comparable analysis of medicine. The introduction of vaccines did not wipe out the medical profession. An analysis based on the material interests of doctors is quite compatible with the altruistic self-conceptions and motivations of doctors in promoting antibiotics, vaccines and some other preventive measures.<sup>69</sup>

Professional support for fluoridation, looked at in organizational terms, has been built on the initial endorsement by the US Public Health Service in 1950, followed shortly thereafter by statements from the American Dental Association and the American Medical Association. These endorsements helped to stimulate support from equivalent bodies in other countries, and internationally from the World Health Organization. In each case active lobbying from interested parties, such as fluoride researchers, took place. In the case of WHO, proponents from the US and other countries fought to establish a pro-fluoridation policy. Endorsements by authoritative bodies have always been important in promoting fluoridation, since they represent professional legitimation.<sup>70</sup>



Support for fluoridation has been likened to an inverted pyramid: there are a very few researchers who are familiar with the evidence, including the (alleged) benefits and risks. The endorsements of professional bodies and the campaigning of the active proponents refer back to the work of these few experts. These endorsements and promotional efforts provide the basis for the support from much of the dental profession, who in turn provide the legitimation when taking the issue to community groups and the general public. This sort of inverted pyramid is characteristic of many issues, and is also found in the anti-fluoridation camp. The difference is that the anti-fluoridationists lack the near-unanimous professional endorsement: activists are more likely to quote directly from scientist critics, whereas pro-fluoridationists are more likely to refer to professional endorsements.

It is the control over professional organizations by pro-fluoridationists which makes possible the 'suppression' of opponents, for example by threatening to debar a dissident from practice. It is the control over political resources associated with the dental and medical professions which gives rise to the major asymmetry in the fluoridation debate. To relativists, it should go without saying that this analysis is quite compatible with a personal judgment that fluoridation is a 'good thing'. It is especially positivists, who see an analysis of the role of professional power as something that may reflect badly on those who exercise it, who prefer to avoid structural analysis of the forces promoting a 'scientific advance'.

The question so far not addressed is: why has water fluoridation been so heavily promoted (in some countries at least) in comparison to some other alternatives, including fluoride tablets, fluoride in salt, fluoride in school water supplies, topical (surface) applications of fluoride, better oral hygiene and better diet? The initial answer is that all of these *have* been tried to a greater or lesser extent. But none has seen quite the intensity of promotion as water fluoridation.<sup>71</sup> If fluoride to reduce tooth decay is the chosen avenue, then three of these alternatives have the great advantage that compulsion is avoided: fluoride tablets, fluoride in salt and topical applications. The options of better oral hygiene and better diet avoid the fluoride debate entirely.

There are some 'logical' reasons which can be brought forward to support water fluoridation in comparison to these alternatives. Fluoride tablets provide a controlled dose to the individual (unlike water fluoridation), but studies show that only a small fraction of parents adhere to the daily regimen of giving these tablets, even when free, to their children for ten or so years. It is claimed by some that topical applications of fluoride by themselves do not have a major effect on caries. Fluoride

in salt is rejected, among other reasons, on the grounds that salt intake should be curtailed and that individual variation in salt intake is larger than individual variation in water intake.

Given the demonstrated public opposition to water fluoridation, much of which can be overcome by avoiding compulsion, some explanation beyond the 'technical' objections to the alternative fluoride approaches is needed. The option of fluoride in salt, for example, is often noted as the second favoured fluoride option after water fluoridation. Fluoride in salt has been adopted in Switzerland, where the opposition to compulsion limited water fluoridation to token levels. The nutritional objections based on sodium intake could have been reduced by promoting a mixture of sodium and potassium chloride, as done by the Finnish government to counter widespread high blood pressure and heart disease. But this type of elaboration of the fluoride-in-salt option has not been undertaken. Two plausible reasons are an interest by dental and medical élites in promoting an option which *is* compulsory — in keeping with the drive by professions to monopolize treatments and reduce the autonomy of clients — and the initial commitment to water fluoridation, creating vested interests by the key promoters in their campaign.

Better diet, especially reduced consumption of sugars, is widely recognized as important for good teeth. Dentists have campaigned for decades for better diet, but a common attitude is that 'you can't change people's eating habits.' The major obstacle to better diet, as perceived by many dentists and doctors, is the enormous promotional efforts by the food industry interacting with the biologically influenced inclination of people to eat sweet foods. While efforts for better diet have had some successes in some places, the food marketplace provides a continual pressure in the opposite direction.

Within the social and economic structures of the time, most dental professionals pushing for preventive measures for better teeth took the path of least resistance: fluoridation. To have made better diet into an all-embracing campaign would have meant continual conflict with the food industries, a powerful economic force. Fluoridation on the other hand, as a technical fix or 'magic bullet',<sup>72</sup> offended no powerful economic or political group while it provided an apparent solution to be implemented through the efforts of the profession with collaboration with the state, guarantors of the dental certification.<sup>73</sup>

Whatever strategy had been pursued, the notion of individual rights could serve as a rallying cry of opponents. Opposition to 'compulsory medication' has been a key objection by opponents of fluoridation. But campaigns for better diet have foundered on the same obstacle facing

fluoride tablets: lack of adherence to the prescription for better health. If bans on certain sugary products (or even just on advertisements for them) had been proposed, the argument of rights would have been used, in this case by the powerful food industry, analogously to the way cigarette manufacturers have used the individual rights argument as their last defence, after debating the health issues had become counterproductive for them.<sup>74</sup>

This outline of a structural analysis of the promotion of fluoridation is not meant to be definitive, but only to suggest how a more detailed analysis might proceed. The point is that this sort of analysis provides a way to approach problems, such as why water fluoridation was promoted in preference to other possible options, which can hardly be asked using the concept of resources.

### **Perspectives on Public Controversies**

An examination of the fluoridation issue provides a good test of different approaches to the study of controversy. In my discussion so far, I first used an approach built on the concept of resources and then used a structural analysis. Each brings tools to the issue which the other leaves undeveloped, and each needs to be enlarged to capture more of the dynamics of the fluoridation controversy.

The resources perspective provides a useful handle for examining the dynamics of scientific knowledge. The fluoridation debate has seen the widespread deployment of claims about knowledge at every level, from the sophisticated to the crass. Attacks on scientific authority using the contingent repertoire are routine. The rhetoric of the debate regularly mixes technical and evaluative statements, for example in claims about what constitutes danger and where the burden of proof lies. But the concept of resources must be broadened to capture a key feature of the dispute — the exercise of professional power to attack scientist opponents. By deregistering dentists, cutting off research grants, denying publication and leading smear campaigns, or threatening or attempting to do these things, the promoters of fluoridation have used professional resources to deny the scientific and personal credibility of opponents.

Both sides in the debate have attempted to promote their cause by mobilizing support, including community groups, the media, government bureaucracies and politicians. The resources perspective can readily be extended to cover this feature of the debate. In doing so it moves out from the sociology of scientific knowledge into a wider political analysis.

But 'science' cannot usefully be distinguished from 'politics' in any case — or at least to do so can be analyzed as a ploy in a particular type of political struggle — and so, by the same token, a strict demarcation between the sociology of scientific knowledge and sociology and politics more generally is a dubious enterprise.

The fluoridation issue highlights the role of professional power as a resource in controversies involving scientific knowledge. Other forms of power also deserve analysis using the resources perspective. The power that men exercise in a patriarchal society is an important feature of science (for example, in disputes over sociobiology or the entry of women into scientific research), but feminist analysis seems to have had little impact on the sociology of scientific knowledge so far.<sup>75</sup> The power of corporations is central in a number of controversies, such as that over herbicides,<sup>76</sup> while the power of the state is central in controversies involving nuclear technology.<sup>77</sup> These and other areas are ripe for extension of the resources perspective.

Structural analysis provides a focus on regularized systems of social interaction which are central to the dynamics of a phenomenon. Structural analysis is one way to carry out the usual study of history, politics, economics and sociology. In the analysis of controversies, it enables going beyond the debate at hand to investigate why it was that this issue came to be debated at all.

The danger in structural analysis is reification of the structures. Social structures are, after all, the result of continual negotiation, reinforcement, adherence and struggle. Reference to the resources perspective provides a valuable corrective to this tendency in structural analysis. Corporate and professional structures did not lead inexorably to the promotion of fluoridation. Rather, these structures provided a political environment congenial to this promotion. It was initially a few enthusiastic promoters in the United States who, using resources in the context of these structures, were able to put fluoridation on the world agenda.

A structural analysis is seldom able to indicate the contingencies of history. Without the 'Wisconsin dentists' who put their dynamic energies behind fluoridation in the 1940s, a national promotion of fluoridation might have been delayed by a decade or longer through the cautiousness of public health officials, long enough to overlap with the rise of environmental concern which might well have made the introduction of wide-scale fluoridation impossible. This scenario suggests that the link between opposition to fluoridation and right-wing individualism was an historically forged connection which, once established, persisted thereafter, and which in other circumstances might have been quite different. The

resources used in the fluoridation struggle by either side might also have been quite different under different historical conditions. It is quite conceivable that the power of the dental and (especially) the medical professions might have been used against a small minority of pro-fluoridationists, rather than the opposite.

There are several other ways to approach the study of controversies, aside from the resources perspective and structural analysis. I will mention three such ways here: positivist studies, group politics and interests analysis.

### *Positivist Studies*

A positivist view of scientific knowledge and of social rationality leads to an analysis in which the forces of progress are pitted against misguided opponents who are influenced by some social, 'non-scientific' factor or other.<sup>78</sup> This is the approach commonly used in science textbooks and elsewhere to explain the 'victory' of science over religion in areas such as the theory of evolution, the demise of the view that the earth is flat, and the defeat of the original Luddites. In contemporary cases, belief in astrology or von Daniken, or opposition to vaccination or pasteurization, are seen, according to this approach, as irrational or retrogressive.

The positivist approach has been used especially to look at fringe movements — and, indeed, any movements which have proved historically unsuccessful. Both scientific 'development' and social history have been written (and rewritten) under the assumption that what happens must be correct. This proves increasingly difficult when contemporary controversies involving science and technology are examined: nuclear power, genetic engineering, pesticides, neutron bombs. These issues, through public debate, are difficult to categorize as 'rationality *versus* irrationality' — or, perhaps more accurately, claims about exclusive possession of rationality are more transparently rhetorical.

As mentioned earlier, most social science studies of the fluoridation controversy are based on the assumption that fluoridation is scientifically proven. Such studies usually end up trying to explain the opposition to fluoridation as due to irrationality, alienation or confusion. This approach is unsuited to analyzing either the dynamics of the struggle or the social structures which shape it.

### *Group Politics*

The group politics approach is built around an examination of the wider politics of a controversial area, such as siting of airports or the use of laetrile in cancer therapy.<sup>79</sup> Typically there is a political struggle between various interest groups, such as between citizen groups and government bureaucracies. In this situation, scientific expertise and knowledge are politicized: some experts align themselves with interest groups, while other experts are drawn upon by partisans to support particular positions. The group politics approach is usually linked to a pluralist, liberal democratic picture of society, in which different interest groups contend for influence in a political marketplace which, while constrained in various ways, is still in many respects a 'free market' in which actors have some autonomy in making decisions.

The theories of knowledge underlying analyses in this vein are not always clear. They may be positivist, in which case politicization of expertise means a biasing, through the politics of public debate, of an underlying objective knowledge. They may also be relativist, in which case politicization of expertise is simply the public face of a deeper social construction of scientific knowledge. Characteristically, this approach is not directly concerned with processes of knowledge creation, but rather with the *uses* of knowledge in public debate.

The group politics approach provides a convenient way to analyze the politics and sociology of decision-making about fluoridation at the community level, within the context of the assumption of pluralism. At its best, it holds the potential to capture the wider political dynamics of controversy which escape the micro-focus of the resources approach, and to highlight the processes of political engagement and challenge which escape the more reified structural analyses. In practice though, the group politics approach often misses out on the strengths of the other approaches: the social construction of scientific knowledge and the structural features of society which provide the context in which interest groups act.

### *Interests Analysis*

Closely related to the resources approach in the sociology of scientific knowledge is the concept of 'interests',<sup>80</sup> such as political and economic structures and prevailing conceptions of what is just and proper. These interests affect the nature of scientific knowledge, for example by influencing perceptions of what the universe should be like. In controversies,

interests provide resources for actors; for example, Darwinians, in promoting their scientific ideas, could draw on images of competition and progress associated with capitalism (capitalist ideologues returned the favour), while anti-Darwinians drew upon the moral authority of the church.

The concept of interests can be used at several levels, including the micro level of individual scientists who have career interests in particular theories,<sup>81</sup> and the macro level of social structures which influence research directions. Micro-level interests might well be included in the 'resources' category and distinguished from macro-level social interests. In any case, the distinction between the resources and interests perspectives is not sharp: those using an interests analysis commonly use the concept of resources, while those engaged in discourse analysis do not rule out the role of what are called interests by others.<sup>82</sup>

Most of those using the interests model in the sociology of scientific knowledge have focused more on the processes of knowledge creation and negotiation within the scientific community than on the dynamics of the interests themselves. In other words, interests are in the background, a resource to draw upon in explaining the dynamics of science.

### *Relating the Approaches*

The interests approach is one way to extend the resources approach, helping to answer the question of where 'resources' come from in the first place; indeed, connections between these two approaches have been well developed. Key interests in the case of fluoridation are industry (industrial producers of fluoride waste, sugary-food manufacturers and toothpaste manufacturers) and professions (the dental and medical professions, and also public health bureaucracies). But rather than treating these interests as a backdrop which influences the behaviour of individual actors such as scientific researchers, it is necessary to analyze the dynamics of the interests themselves, which means moving in the direction of group politics and structural analysis.

In the earlier discussion of structural analysis, I did not delve into the construction of scientific knowledge related to fluoride. It is straightforward to link this sort of analysis to the interests perspective as applied within the scientific community. Because the processes involved are often quite blunt and overt, a sophisticated analysis of the epistemological effect of background interests is not necessary for some initial conclusions. For example, aluminium companies will fund fluoride research so long as

fluoride is not attacked publicly.<sup>83</sup> This immediately affects the direction of research, the style of reporting of findings and most likely the findings themselves. Another example is the alleged misrepresentation and suppression of findings which show potential dangers of fluoridation. In the 1950s, Alfred Taylor studied the effect of fluoride on cancer in mice. His methods were severely criticized. After improving the methods, his results were still attacked on the basis of *previous* shortcomings.<sup>84</sup> In this case, discourse affecting the status of scientific knowledge is overtly influenced by objectives of promoting or opposing fluoridation — in other words, by social interests embodied in scientists and others involved in the controversy. It seems unnecessary to undertake a detailed analysis of discourse at the laboratory level, when the 'negotiations' over the status of knowledge claims are carried out in the form of attacks made in journals and publicity handouts.

Four of the approaches for analyzing controversies can be allocated diagrammatically using two axes: actors or structures, and a focus inside or outside the scientific community (see Figure 1).

**FIGURE 1**  
Focus of Study

|                         |            | Inside the<br>Scientific<br>Community | Outside the<br>Scientific<br>Community |
|-------------------------|------------|---------------------------------------|----------------------------------------|
| Level<br>of<br>Analysis | Actors     | Resources                             | Group Politics                         |
|                         | Structures | Interests                             | Structural<br>Analysis                 |

Note that the positivist approach is not included in this diagram. The resources and interests approaches are normally linked to a relativist epistemology, while the approaches focusing outside the scientific community may be associated with a number of different epistemologies. The categories in this diagram indicate some of the directions from which



the social study of controversies may proceed. Of course, many studies draw on elements of more than one approach.<sup>85</sup>

## **Conclusion**

In summary, each of the approaches, aside from the positivist approach, provides useful insights into the fluoridation controversy but must be extended to capture more of what is going on. The group politics approach is useful for analyzing the political battles which have been a prominent feature of community conflict over fluoridation, but does not address either the structural forces behind fluoridation nor the role of power in shaping what is judged as being scientific knowledge. Structural analysis takes up the first of these areas; it allows examination of issues not readily dealt with through the other approaches, such as why water fluoridation was promoted originally. Structural analyses tend to reify social relations; reference back to actors and social struggles provides a useful corrective to this tendency. The resources and interests approaches are very effective, but in order to deal with important features of the issue they need to be extended. Instead of focusing only on scientific knowledge and authority as resources, other things need to be brought in as resources, especially professional power. Likewise, the interests approach needs to be 'opened up' by providing a political analysis of interests, treating them as dynamic factors rather than just background structures or influences. Extending the resources and interests approaches in this way brings them much closer to group politics and structural analysis.

An examination of different ways to approach the fluoridation issue also provides some perspective on the relation of social studies of fluoridation to the fluoridation debate. There are practitioners of all approaches discussed here who hold that social science can be, or should be, simply another form of scientific, naturalistic investigation. But in practice the approach taken, as well as the conclusions reached, end up aiding one side more than the other in the debate (at least if the social science studies are read by anyone outside the specialist social science community). Positivist studies, because they assume that science supports fluoridation, are usually useful to the fluoridation cause. The relativist resources and interests approaches, because they treat the knowledge claims of the sparring parties symmetrically, aid the anti-fluoridationists, because they do not openly endorse the scientific claims of the pro-fluoridationists. By treating the issue as a controversial one, the relativist implies, at least to outsiders, that there is some substantial scientific disagreement, something

which is denied by many pro-fluoridationists. The implications of the group politics approach and of structural analysis are more variable, depending largely on their underlying conceptions of knowledge. Structural analysis, if it analyzes the role of corporate and professional interests in fluoridation, can readily be used to attack fluoridation, and certainly the few structural analyses of the issue have been used this way.

Social scientists may hope to avoid being parties to controversies by claiming to be just another variety of scientist. Such claims should be treated similarly to the way sociologists of scientific knowledge treat claims by scientists — namely, as ploys in a social struggle in which it is advantageous to be seen to be above the struggle.

## • NOTES

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1. See, for example, J. J. Murray and A. J. Rugg-Gunn, *Fluoride in Caries Prevention* (Bristol: Wright PSG, 1982); E. Newbrun (ed.), *Fluorides and Dental Caries* (Springfield, IL: Charles C. Thomas, 1975).

2. See, for example, J. Colquhoun, 'New Evidence on Fluoridation', *Social Science and Medicine*, Vol. 19 (1984), 1239–46; M. Diesendorf, 'The Mystery of Declining Tooth Decay', *Nature*, Vol. 322 (10 July 1986), 125–29.

3. Reviews of social science research on fluoridation include P. J. Frazier, 'Fluoridation: a Review of Social Research', *Journal of Public Health Dentistry*, Vol. 40 (1980), 214–33; A. B. Motz, 'The Fluoridation Issue as Studied by Social Scientists', in N. D. Richards and L. K. Cohen (eds), *Social Sciences and Dentistry: A Critical Bibliography* (The Hague: A. Sijthoff, 1971), 347–66.

4. See, for example, W. A. Gamson, 'Public Information in a Fluoridation Referendum', *Health Education Journal*, Vol. 19 (1961), 47–54; T. F. A. Plaut, 'Analysis of Voting Behavior on a Fluoridation Referendum', *Public Opinion Quarterly*, Vol. 23 (1959), 213–22.

5. W. A. Gamson, 'The Fluoridation Dialogue: Is It an Ideological Conflict?', *Public Opinion Quarterly*, Vol. 25 (1961), 526–37; A. L. Green 'The Ideology of Anti-Fluoridation Leaders', *Journal of Social Issues*, Vol. 17 (1961), 13–25; E. L. Linn, 'An Appraisal of Sociological Research on the Public's Attitudes Toward Fluoridation', *Journal of Public Health Dentistry*, Vol. 29 (1969), 36–45; A. Simmel, 'A Signpost for Research on Fluoridation Conflicts: The Concept of Relative Deprivation', *Journal of Social Issues*, Vol. 17 (1961), 26–36.

6. R. L. Crain, E. Katz and D. B. Rosenthal, *The Politics of Community Conflict: The Fluoridation Decision* (Indianapolis, IN: Bobbs-Merrill, 1969), 58–70; H. M. Sapolsky,

'Science, Voters, and the Fluoridation Controversy', *Science*, Vol. 162 (25 October 1968), 427-33; Sapolsky, 'The Fluoridation Controversy: An Alternative Explanation', *Public Opinion Quarterly*, Vol. 33 (1969), 240-48.

7. Crain et al., op. cit. note 6, provide the most comprehensive critique of the alienation hypothesis.

8. E. Auermann and H. Lingelbach, 'Status and Prospects of Fluoridation in Europe', *American Journal of Public Health and the Nation's Health*, Vol. 54 (1964), 1545-50; E. J. Farkas, 'Water Fluoridation in Eleven Countries', *Social Sciences and Medicine*, Vol. 16 (1982), 2155-58; J. R. Forrest, 'The Effectiveness of Fluoridation in Europe', *British Dental Journal*, Vol. 123 (1967), 169-75; R. B. Scobie, 'Water Fluoridation: A Survey of the International Picture', *Alabama Journal of Medical Science*, Vol. 12 (1975), 225-29.

9. J. S. Coleman, *Community Conflict* (New York: Free Press, 1957); Crain et al., op. cit. note 6; B. W. Head, 'The Fluoridation Controversy in Victoria: Public Policy and Group Politics', *Australian Journal of Public Administration*, Vol. 37 (1978), 257-73; A. Mitchell, 'Fluoridation in Dunedin: A Study of Pressure Groups and Public Opinion', *Political Science*, Vol. 12 (1960), 71-93; M. Pinard, 'Structural Attachments and Political Support in Urban Politics: The Case of Fluoridation Referendums', *American Journal of Sociology*, Vol. 68 (1963), 513-26.

10. A. Mazur, 'Disputes between Experts', *Minerva*, Vol. 11 (1973), 243-62; Mazur, *The Dynamics of Technical Controversy* (Washington, DC: Communications Press, 1981).

11. Mazur notes the importance of other factors, such as McCarthyism and environmentalism, but does not deal with them in any depth.

12. The most engaging account of this search and discovery is D. R. McNeil, *The Fight for Fluoridation* (New York: Oxford University Press, 1957). See also F. J. McClure, *Water Fluoridation: The Search and the Victory* (Bethesda, MD: US Department of Health, Education and Welfare, 1970).

13. McNeil, op. cit. note 12.

14. See note 8.

15. Crain et al., op. cit. note 6, 22, 122-34.

16. See, for example, H. M. Collins, 'The Seven Sexes: A Study in the Sociology of a Phenomenon, or the Replication of Experiments in Physics', *Sociology*, Vol. 9 (1975), 205-24; Collins, 'Son of Seven Sexes: The Social Destruction of a Physical Phenomenon', *Social Studies of Science*, Vol. 11 (1981), 33-62; G. N. Gilbert and M. Mulkay, *Opening Pandora's Box: A Sociological Analysis of Scientists' Discourse* (Cambridge: Cambridge University Press, 1984); Mulkay & Gilbert, 'Putting Philosophy to Work: Karl Popper's Influence on Scientific Practice', *Philosophy of the Social Sciences*, Vol. 11 (1981), 389-407; B. Harvey, 'The Effects of Social Context on the Process of Scientific Investigation: Experimental Tests of Quantum Mechanics', in K. D. Knorr, R. Krohn and R. Whitley (eds), *The Social Process of Scientific Investigation* (Dordrecht: D. Reidel, 1980), 139-63; B. Latour and S. Woolgar, *Laboratory Life: The Social Construction of Scientific Facts* (London: Sage, 1979); T. J. Pinch, 'The Sun-Set: The Presentation of Certainty in Scientific Life', *Social Studies of Science*, Vol. 11 (1981), 131-58. Some of these studies would not normally be considered controversy studies, but then the focus in many studies in this vein is on how consensus is promoted and not, for example, on how polarization is sustained or aggravated.

17. Mazur, op. cit. note 10.

18. See, for example, *How to Obtain Fluoridation for Your Community Through a Citizen's Committee* (Chicago: American Dental Association, 1953), 11-12.

19. Anonymous [J. Botta], 'Six Ways to Mislead the Public', *Consumer Reports*, Vol. 43 (1978), 480–82: 'The simple truth is that there's no "scientific controversy" over the safety of fluoridation' (482). See also G. L. Waldbott, in collaboration with A. W. Burgstahler and H. L. McKinney, *Fluoridation: The Great Dilemma* (Lawrence, KS: Coronado Press, 1978), 332–33.

20. See, for example, L. I. Dublin, 'Water Fluoridation: Science Progresses Against Unreason', *Health Education Journal*, Vol. 15 (1957), 246–50: 'In the current battle there is more at stake than dental health. We, in the health professions, are in the front lines, defending scientific thought against hysteria, confusion and unreason. We must not fail' (250). See also the influential paper B. Mausner and J. Mausner, 'A Study of the Anti-scientific Attitude', *Scientific American* (February 1955), 35–39. Many other examples could be produced.

21. H. M. Collins and T. J. Pinch, 'The Construction of the Paranormal: Nothing Unscientific is Happening', in R. Wallis (ed.), *On the Margins of Science: The Social Construction of Rejected Knowledge* (Keele: University of Keele, 1979), 237–69; G. N. Gilbert and M. Mulkay, 'Warranting Scientific Belief', *Social Studies of Science*, Vol. 12 (1982), 383–408; Mulkay & Gilbert, 'Accounting for Error: How Scientists Construct their Social World when they Account for Correct and Incorrect Belief', *Sociology*, Vol. 16 (1982), 165–83.

22. The use of the contingent repertoire by anti-fluoridationists is illustrated by the frequent reference to a 1951 conference in Washington attended by dental health representatives from around the country, with members of the US Public Health Service. In one of the talks, fluoridation promoter Francis A. Bull described his techniques, which included calling mottled teeth 'egg-shell white', calling the fluoridation trials 'demonstrations' rather than 'experiments' and, concerning the effectiveness of fluoridation, saying 'we have told the public that it works, so we cannot go back on that' (Waldbott et al., op. cit. note 19, 263–68). This talk was intended for insiders; even if the relevance of this conference decades later is debatable, by being quoted to others it undermines the aura of objectivity otherwise associated with fluoridation.

23. McNeil, op. cit. note 12, 84.

24. This agrees with the finding by S. L. Del Sesto, 'Uses of Knowledge and Values in Technical Controversies: the Case of Nuclear Reactor Safety in the US', *Social Studies of Science*, Vol. 13 (1983), 395–416, that the 'establishment' uses more cognitive statements while the critics use relatively more evaluative statements.

25. R. Isman, 'Fluoridation: Strategies for Success', *American Journal of Public Health*, Vol. 71 (1981), 717–21: 'Several authors have recommended that debates be avoided and I concur with this recommendation. There is little to gain and much to lose from debating an emotional issue like fluoridation. A debate simply serves to give more credibility to fluoridation opponents' (721). See also M. W. Easley, 'The New Antifluoridationists: Who Are They and How Do They Operate?', *Journal of Public Health Dentistry*, Vol. 45 (1985), 133–41 (see 138); H. M. Raulet, 'The Health Professional and the Fluoridation Issue: A Case of Role Conflict', *Journal of Social Issues*, Vol. 17 (1961), 45–54 (see 49–51); P. R. N. Sutton, *Fluoridation, 1979: Scientific Criticisms and Fluoride Dangers* (Melbourne: P. R. N. Sutton, 1980), 8; M. Wollan, 'Controlling the Potential Hazards of Government-Sponsored Technology', *George Washington Law Review*, Vol. 36 (1968), 1105–37 (see 1133).

26. See Motz, op. cit. note 3, 358 for numerous references.

27. Raulet, op. cit. note 25.

28. The view that political methods must be used to promote fluoridation is forcibly put by D. R. McNeil, 'Political Aspects of Fluoridation', *Journal of the American Dental*

*Association*, Vol. 65 (1962), 97–100. See also B. A. Burt and E. O. Petterson, 'Fluoridation: Developments in Sweden', *British Dental Journal*, Vol. 133 (1972), 57–59.

29. J. Marmor, V. W. Bernard and P. Ottenberg, 'Psychodynamics of Group Opposition to Health Programs', *American Journal of Orthopsychiatry*, Vol. 30 (1960), 330–45: 'Since health legislation is ordinarily introduced only after having been first recommended or endorsed by responsible scientific authorities, it is not surprising to find that, in the opposition which develops, the part which is based on rational considerations tends to occupy a considerably narrower band on the spectrum than that which is irrational and unconsciously motivated or else deliberately dishonest. Nevertheless, the former group is an extremely important one, not only because it lends prestige and scientific authority to the opposition and so influences large numbers of people whose resistances might otherwise not have been aroused . . .' (330). This is one of the very few social science studies of fluoridation which admits that rational opposition to the measure may exist. It is usually cited by pro-fluoridationists as suggesting that all opposition is irrational.

30. See for example *National Fluoridation News* in the United States.

31. B. L. Campbell, 'Uncertainty as Symbolic Action in Disputes among Experts', *Social Studies of Science*, Vol. 15 (1985), 429–53, describes how experts are 'deployed' by competing interest groups to serve their own purposes, a process which characterizes the fluoridation issue as well.

32. This is a feature of my interviews with leading proponents and opponents of fluoridation in Australia, which will be reported elsewhere. Numerous examples of abusive attacks can be found in writings on both sides of the debate.

33. Bureau of Public Information, American Dental Association, 'Comments on Opponents of Fluoridation', *Journal of the American Dental Association*, Vol. 65 (1962), 132–48; *ibid.*, Vol. 71 (1965), 1155–83.

34. G. L. Waldbott, *A Struggle with Titans* (New York: Carlton Press, 1965), 66. This is a key reference in describing actions taken against anti-fluoridationists, with much better documentation than most anti-fluoridation literature.

35. See McClure's (op. cit. note 12, 264–65) treatment of Waldbott, in an otherwise fairly restrained discussion of criticisms of fluoridation. Wollan, op. cit. note 25, 1133, describes how a US Public Health Service scientist dismissed a Canadian study because one of the authors did not have a PhD.

36. Anonymous [J. Botta], 'Fluoridation: The Cancer Scare', *Consumer Reports*, Vol. 43 (1978), 392–96.

37. J. Yiamouyiannis, *Fluoride: The Aging Factor* (Delaware, OH: Health Action Press, 1983), 143–46.

38. See also S. Barrett and S. Rovin (eds), *The Tooth Robbers: A Pro-fluoridation Handbook* (Philadelphia, PA: George F. Stickley Company, 1980), for attacks on the National Health Federation. The wide dissemination of particular information about Yiamouyiannis was apparent from my interviews with proponents of fluoridation in Australia.

39. Waldbott, op. cit. note 34, 140–41. See also Raulet, op. cit. note 25, 46: 'In neither city did a local physician or dentist work actively and openly against the fluoridation proposal, but the proponents, very much concerned with professional solidarity in the matter, were quite bitter toward their few colleagues who refused to sign the endorsement.'

40. Waldbott, op. cit. note 34, 43.

41. *Ibid.*, 201.

42. *Ibid.*, 237.

43. *Ibid.*, 249.

44. Ibid., 312.
45. Ibid., 311.
46. Ibid., 341–42. See also Waldbott et al., op. cit. note 19, 323.
47. C. Farkas, letter to B. Martin, 6 April 1986.
48. Waldbott, op. cit. note 34, 249.
49. A. Schatz, 'Some Comments on Two Books Dealing With the Toxicology of Fluorine Compounds', *Pakistan Dental Review*, Vol. 15 (1965), 68–71; Waldbott, op. cit. note 34, 276–85.
50. W. Varney, *Fluoride in Australia: A Case to Answer* (Sydney: Hale & Iremonger, 1986), 95; A.-L. Gotzsche, *The Fluoride Question* (London: Davis-Poynter, 1975), 17; J. Polya, personal communication. See Polya, *Are We Safe?* (Melbourne: Cheshire, 1964), for his arguments on fluoridation.
51. G. S. R. Walker, *Fluoridation: Poison on Tap* (Melbourne: Glen Walker, 1982), 196–203; G. E. Smith, 'Fluoride: The Frightening Facts', *Simply Living*, Vol. 2, No. 1 (1983), 29–36 (see 34).
52. S. G. Kings, Federal President, Australian Dental Association, letter to The Chairman, CSIRO, 14 February 1984; C. H. Wall, Executive Director, Australian Dental Association, letter to J. P. Wild, Chairman, CSIRO, 21 August 1985; N. L. Henry, Federal President, Australian Dental Association, letter to B. O. Jones, Minister for Science and Technology, 28 August 1985.
53. See the numerous cases in Sutton, op. cit. note 25, 23–24; Waldbott et al., op. cit. note 19, 318–52; Yiamouyiannis, op. cit. note 37, 121, 125–26, 128–30, 149, 151, 157; and, less reliably, G. Caldwell and P. E. Zanfagna, *Fluoridation and Tooth Decay* (Reseda, CA: Top-Ecol Press, 1974), 15–16, 39–40, 45, 53–72. Mazur (1981), op. cit. note 10, 30, gives no examples but implies that one approach used has been to 'suppress, discredit, or ignore technical criticism'.
54. N. Brugge, Secretary, National Pure Water Association, letter to B. Martin, 19 November 1986. But note the claim by R. S. Scorer, 'Teething Troubles', *New Ecologist*, Vol. 9 (March–April 1979), 70–71: 'I know of one paper rejected by a prestigious British journal on the grounds that it would cause public alarm if published — it raised the issue of a possible relationship between fluoride and cancer mortality' (71).
55. M. Diesendorf, Letter to the Editor, *New Doctor*, No. 19 (April 1981), 2.
56. Waldbott, op. cit. note 34, 323.
57. Waldbott et al., op. cit. note 19, 334–35.
58. T. F. Gieryn, 'Boundary-work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists', *American Sociological Review*, Vol. 48 (1983), 781–95.
59. Members of a number of groups have been prominent in opposition to fluoridation, such as 'health-food enthusiasts', chiropractors, Christian Scientists and some right-wing groups: see Barrett & Rovin, op. cit. note 38; Easley, op. cit. note 25; D. R. McNeil, *Fluoridation for Your Community and Your State* (American Dental Association, 1969), 13–14. But, as recognized by most analysts, fluoridation has not been a central issue for any of these groups, nor have these groups played a central role in the opposition as a whole. Nor can any of these groups be considered integral to a 'dominant' social structure, as can, for example, a powerful profession or a major fraction of capital or the state. Finally, the opposition has largely been a reaction against the initiative for fluoridation; the agenda of the fluoridation issue was set by the proponents. So, while it would be possible to press a structural analysis of the opposition to fluoridation further than has been done before, the value of this sort of analysis is better illustrated by examination of the promotion of fluoridation.

60. Varney, op. cit. note 50, is the most systematic structural analysis of the promotion of fluoridation. See also Waldbott et al., op. cit. note 19, 295–317; M. Diesendorf and W. Varney, 'Fluoridation: Politics and Strategies', *Social Alternatives*, Vol. 5, No. 2 (1986), 48–53. The general argument is widely raised in a very crude form in the anti-fluoridationist literature.

61. Waldbott et al., op. cit. note 19, 289–91.

62. McNeil, op. cit. note 12, 139.

63. Waldbott et al., op. cit. note 19, 310.

64. Varney, op. cit. note 50, 72–73.

65. Crain et al., op. cit. note 6.

66. R. Collins, *The Credential Society* (New York: Academic Press, 1979); E. Friedson, *Professional Dominance: The Social Structure of Medical Care* (New York: Atherton, 1970); T. J. Johnson, *Professions and Power* (London: Macmillan, 1972); M. S. Larson, *The Rise of Professionalism: A Sociological Analysis* (Berkeley, CA: University of California Press, 1977); E. Willis, *Medical Dominance: The Division of Labour in Australian Health Care* (Sydney: Allen & Unwin, 1983).

67. In relation to bureaucracies, see D. Weinstein, *Bureaucratic Opposition: Challenging Abuses at the Workplace* (New York: Pergamon, 1979). In relation to academia, see M. O. Furner, *Advocacy and Objectivity: A Crisis in the Professionalization of American Social Science, 1865–1905* (Lexington, KY: University Press of Kentucky, 1975), and B. Martin, C. M. A. Baker, C. Manwell and C. Pugh (eds), *Intellectual Suppression* (Sydney: Angus & Robertson, 1986).

68. D. O. deShazer, 'Knowledge and Opinions of Dental Students on Fluoridation', *Journal of Dental Education*, Vol. 31 (1967), 28–33, found that twice as many later-year dental students answered no as answered yes to the question, 'If a cure of dental caries is found in the next 5 years, do you feel that this benefit to mankind will affect your income as a dentist?' (32). Sutton, op. cit. note 25, 47–53, refers to several studies showing that fluoridation, contrary to claims by its supporters, has not led to a reduction in the number of dentists.

69. L. Doyal, *The Political Economy of Health* (London: Pluto, 1979); I. Illich, *Medical Nemesis: The Expropriation of Health* (London: Calder & Boyars, 1975).

70. Sutton, op. cit. note 25, 15–23; Varney, op. cit. note 50; Waldbott et al., op. cit. note 19.

71. McClure, op. cit. note 12, 175–90, provides a useful discussion of different ways of using fluoride. See also J. J. Murray (ed.), *Appropriate Use of Fluorides for Human Health* (Geneva: World Health Organization, 1986).

72. M. Diesendorf (ed.), *The Magic Bullet* (Canberra: Society for Social Responsibility in Science [ACT], 1976); B. Dixon, *Beyond the Magic Bullet* (London: Allen & Unwin, 1978).

73. On the role of the state in fluoridation see Varney, op. cit. note 50, 109–32.

74. P. Taylor, *The Smoke Ring: Tobacco, Money and Multinational Politics* (London: Sphere, 1985), 199–200.

75. S. Harding, *The Science Question in Feminism* (Ithaca, NY: Cornell University Press, 1986).

76. R. van den Bosch, *The Pesticide Conspiracy* (Garden City, NY: Doubleday, 1978); S. S. Epstein, *The Politics of Cancer* (San Francisco, CA: Sierra Club Books, 1978).

77. B. Martin, 'Nuclear Suppression', *Science and Public Policy*, Vol. 13 (1986), 312–20.

78. As well as numerous textbooks and other accounts, especially worthy of note are guardians of the boundaries of science such as M. Gardner, *Science: Good, Bad, and Bogus* (New York: Avon, 1981).

79. The approach of Dorothy Nelkin is most characteristic here: D. Nelkin, *Nuclear Power and its Critics: The Cayuga Lake Controversy* (Ithaca, NY: Cornell University Press, 1971); Nelkin, 'The Political Impact of Technical Expertise', *Social Studies of Science*, Vol. 5 (1975), 35–54. Studies of a similar orientation are represented in Nelkin (ed.), *Controversy: Politics of Technical Decisions* (Beverly Hills, CA: Sage, 1979). See also P. M. Boffey, *The Brain Bank of America: An Inquiry into the Politics of Science* (New York: McGraw-Hill, 1975); D. S. Greenberg, *The Politics of Pure Science* (New York: New American Library, 1967); J. Primack and F. von Hippel, *Advice and Dissent: Scientists in the Political Arena* (New York: Basic Books, 1974).

80. See, for example, B. Barnes, *Scientific Knowledge and Sociological Theory* (London: Routledge & Kegan Paul, 1974); Barnes, *Interests and the Growth of Knowledge* (London: Routledge & Kegan Paul, 1977); Barnes, *T. S. Kuhn and Social Science* (London: Macmillan, 1982); D. Bloor, *Knowledge and Social Imagery* (London: Routledge & Kegan Paul, 1976); P. Forman, 'Weimar Culture, Causality, and Quantum Theory, 1918–1927: Adaptation by German Physicists and Mathematicians to a Hostile Intellectual Environment', *Historical Studies in the Physical Sciences*, Vol. 3 (1971), 1–115; J. Harwood, 'The Race-Intelligence Controversy: a Sociological Approach', *Social Studies of Science*, Vol. 6 (1976), 369–94 and Vol. 7 (1977), 1–30; D. MacKenzie, 'Statistical Theory and Social Interests: A Case-Study', *Social Studies of Science*, Vol. 8 (1978), 35–83; S. Shapin, 'The Politics of Observation: Cerebral Anatomy and Social Interests in the Edinburgh Phrenology Disputes', in Wallis, op. cit. note 21, 139–78; R. M. Young, 'The Historiographic and Ideological Contexts of the Nineteenth-Century Debate on Man's Place in Nature', in M. Teich and Young (eds), *Changing Perspectives in the History of Science* (London: Heinemann, 1973), 344–438.

81. For example, M. Callon and J. Law, 'On Interests and Their Transformation: Enrolment and Counter-Enrolment', *Social Studies of Science*, Vol. 12 (1982), 615–25.

82. For criticisms of interests analysis, see S. Woolgar, 'Interests and Explanation in the Social Study of Science', *Social Studies of Science*, Vol. 11 (1981), 365–94; S. Yearley, 'The Relationship between Epistemological and Sociological Cognitive Interests: Some Ambiguities Underlying the Use of Interest Theory in the Study of Scientific Knowledge', *Studies in History and Philosophy of Science*, Vol. 13, (1982), 353–88. See also the replies by B. Barnes, 'On the "Hows" and "Whys" of Cultural Change (Response to Woolgar)', *Social Studies of Science*, Vol. 11 (1981), 481–98; D. MacKenzie, 'Interests, Positivism and History', *ibid.*, 498–504; MacKenzie, 'Reply to Yearley', *Studies in History and Philosophy of Science*, Vol. 15 (1984), 251–59.

83. Waldbott, op. cit. note 34, 21, 131, 249, 335. Waldbott argues that, in the US, very little money is available for fluoride research from bodies which do not have an interest in minimizing its danger.

84. *Ibid.*, 235.

85. For example, Mazur, op. cit. note 10, analyzes the use of rhetorical resources under the assumption that facts can or should be distinguished from values, and also deals with the dynamics of protest in a way which I would categorize as group politics. By contrast, one referee commented that Mazur uses a structural analysis in which the structures are social networks; this is a different conception of structures than I have used. It is not my object to try to put particular writers into particular boxes, but rather to make observations about the strengths and limitations of some general approaches, especially the need to include an analysis of the active exercise of professional power in studying controversies.



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