are not so committed. The history of science has repeatedly demonstrated that more than one theoretical construction can usually be placed upon a given collection of data. It is apparent that belief in, and commitment to, the fluoridation paradigm strongly influenced New Zealand health professionals in their interpretation of the Hastings data. Many of the participants in the above events are still living. They have been invited to comment on the information presented in this chapter (47).

Conclusion

From the above considerations it seems clear that the Hastings fluoridation study did not, as it was purported to do, demonstrate the effectiveness of water fluoridation in reducing dental decay in a typical New Zealand population. The reported reductions were at least partly, if not wholly, the result of factors other than fluoridation. Today proponents of fluoridation will concede that there were other factors operating to cause the reductions, over and above any fluoridation effect. But that fact, although known to those responsible for the study, was never reported in official and scientific published reports on it. Deserving of consideration is the extent to which the same situation might apply to the many "no control" fluoridation studies in other countries. The study was more a public relations exercise, part of the programme for public education for fluoridation, than a

47. As mentioned in the Preface, the author is indebted to Brigadier J Ferris Fuller for the frank information in his letters to the author, written after consulting his "voluminous files" which he regarded as "the story of day to day planning, advising, co-ordinating, explaining and encouraging - in my view purely personal and not public property." However, as was pointed out in one of his letters, "other aspects and indeed the story as a whole are available to someone like yourself from official files and papers." The story as related in this chapter has so relied on official sources. A future historian might some day fill in details from Fuller's files.
scientific one. Nonetheless, it is still cited in scientific literature and textbooks as being the latter.

The reason for the distortions, manipulations and withholding of relevant information was apparently to educate the New Zealand public about a "truth", which the professionals in charge of the project already believed was basically established. The various activities and decisions outlined in this and earlier chapters were all geared to that end. There appears to have been no conscious fraud or misrepresentation, of the kind finally practised by Cyril Burt in defence of his crumbling paradigm. The self-righteous indignation of the professionals, at the continued opposition to their plans from members of the public and from a few scientists whom they, the proponents, really believed to be misguided "cranks", is quite evident from all the recorded actions and decisions. Such was their confidence in the soundness of the United States findings, that when the facts did not fit their accepted theory, they unitedly sought and found an explanation. It was the facts, not the theory, which were questioned. Whether their actions were consciously deceptive or fraudulent, which this author doubts, is not the most important issue. The actions were taken for what the actors considered were the best possible reasons and purposes. The picture which emerges is a classic one of an elite group wielding professional and scientific power in order to influence public opinion and policy.
CONCLUSION
CONCLUSION

This thesis has traced the history of water fluoridation, especially in New Zealand, since the time when the public health procedure was introduced to the world, from the United States, almost forty years ago. Changes which have affected the body of knowledge, or "paradigm", on which the procedure is based were also examined. Data on child dental health in New Zealand, from past years and today, combined with new information about past events, supported the conclusions of critics in other countries that radical reassessment of the paradigm is overdue. Nonetheless, the paradigm is still widely accepted by the national and most local governments, and strongly defended by the professional authorities who promoted it in the past. There has until recently been very little input to the fluoridation controversy from historical and sociological viewpoints. Diesendorf, Varney and Martin have commenced re-examinations of the paradigm's history from scientific, political and sociological perspectives. In the present thesis a further attempt has been made, from an educational angle, to indicate the value of such approaches.

The present study was an historical one undertaken with educational aspects of the paradigm especially in view. The first such aspect, the subject of Part I, was an examination of the paradigm itself, from the historical perspective developed by Kuhn. The picture which emerged was consistent with Kuhn's description of a paradigm entering, or about to enter, a period of crisis. Some of the processes which led to construction of the paradigm have also been examined. The New Zealand evidence examined in Parts II and III was also consistent with the above picture. Much more than rational or "scientific" appraisals of
objective data seem to have been involved. Professional resources have been used to lessen the credibility of scientific opponents. In this endeavour state and social agencies were co-opted in order to reinforce the message, which was to portray the fluoridation policy as "common sense" and beyond dispute. The main state agencies so used were the government departments, in particular the Department of Health. But other, state-funded, bodies like the Medical Research Council and the Universities, were also closely involved. The main social agencies were the newspapers and other media which were and are, of course, powerful educative forces. Such professional behaviour involving cognitive interests, indirectly connected to professional status and power, seems to be associated with a "mind set" of the participants. Those interests now include a collective investment in past decisions.

In discussing this intellectual outcome of paradigms within scientific disciplines, Clark and Westrum have concluded that more attention needs to be given to the organizational interests which influence scientists' opinions.

"The establishment's key resource is legitimacy. A constant propaganda presents the institution involved as expert, objective and comprehensive, their opinion as the opinion of professional science. As the establishment becomes larger and more dominant, it can present its critics as misguided, badly informed or even dishonest. A scientific establishment, then, represents not only a concentration of opinion but also a concentration of power." (1)

The next aspect examined in the thesis was an inquiry, in Part II, into some likely alternative explanations for the decline in dental decay which has occurred over the period. While the decay-arresting property of fluorides cannot be ruled out as a contributing factor, it

1. T Clark, R Westrum: Paradigms and ferrets Social Studies of Science 1987;17:3-33
became clear that it was not the most important one, as adherents of the paradigm still assert. Although it will probably never be possible to gauge the relative weight of contributing factors with any degree of certainty, a case was made that health education, especially in conjunction with school dental services, has been underrated in the past and should be rehabilitated and granted more recognition. The case for such rehabilitation is greatly strengthened by increasing evidence which undermines exaggerated claims for fluoridation.

The third aspect, examined in Part III, was a more detailed examination, in New Zealand, of the role of education in promoting fluoridation. These ranged from the formal education of professional proponents, and their continuing education through professional networks, to the public education programmes designed to secure public acceptance of fluoridation. More subtle methods of public persuasion, including a commission of inquiry and the publicizing of supposedly scientific demonstrations, were investigated. The role of informal processes, such as those that stem from the advertising of fluoride products, was also touched upon. Exposure of some of the methods by which such promotional measures are implemented can be a salutary lesson on the dangers of elite policy formation by professional experts.

The term "education" was employed in various ways, which is necessary if one is to describe the many different aspects of the role of education in modern societies. In addition to schooling, which has many aspects in addition to that of formal curricula, these aspects have been touched upon, in both parts of the thesis. They include the influence of the media and of advertising, as well as the function of commissions of inquiry, the activities of professional networks and the
mode of presenting "authoritative" research results. Some might argue that efforts designed to promote values or ideologies, rather than to impart information, do not qualify as education. But the way in which promoters of fluoridation have consistently labelled opponent efforts as "propaganda", while reserving the term "education" for their own efforts, demonstrates how subject such a division is to differing interpretation. History abounds with examples. The "subversion" of yesteryear often but not always becomes the "enlightenment" of today. Thus the historical study of education, and of the educational aspects of controversies, is an appropriate, if not indispensable, method for illuminating the value-laden character and cultural basis of supposedly "impartial and independent" texts. Silver and Simon point out that history often shows the reasons for sharp policy changes and reversals of view (2).

That problem of definition raises the question of relativism in science education. In the Introduction reference was made to the open-ended discussion approach to scientific controversies. More can be involved than merely allowing or encouraging expression of opposing "positivist" viewpoints in the classroom, instructive and broadening as that may be. The "interests and resources" and "politics and analysis" approaches described by Brian Martin permit further insights into the origins of differing opinions in science. The relativism shared by some of those approaches need not deny the possibility of objective knowledge, and can in fact bring us closer to such knowledge. The implementation of such a programme in the classroom might present some problems. The major problem could lie in the character of formal

1985