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In the spring of 1973, the National Caries Program sponsored a workshop on the
Physicochemical Mechanisms of Dental Caries which confirmed that the caries process is too
complex and knowledge of its mechanism is still too limited to assess the importance of its many
aspects with finality. Nevertheless, that workshop pointed toward new areas of thought,
generated co-operation between diverse scientific disciplines, and provided the foundation for
the present workshop on ‘Cariostatic Mechanisms of Fluorides’. The primary objective of the
The present workshop was to provide a basis of information that will lead to more effective fluoride regimens for the prevention of dental caries. This was accomplished by critically reviewing the clinical, nutritional, biochemical, microbiological and physico-chemical information pertinent to the problem, by assessing the various mechanisms of fluoride action that have been proposed, and by suggesting profitable areas for future research endeavors. Because the preventive value of fluorides, both from fluoridated water and various types of topical applications is accepted by the vast majority of workers in the field, fluoride has been the topic of many conferences. The present workshop, however, was unique in that it placed major emphasis on understanding the mechanisms whereby fluorides reduce the occurrence of dental caries. It also emphasized interdisciplinary cooperation and exchange and provided an opportunity to explore the various proposed mechanisms of action of fluorides from different points of view. Important ideas and recommendations are summarized in the three task force reports at the end of this publication. The reader may wish to review these initially before studying the individual papers.

The main theme present in the task force reports and throughout many of the papers is that we still have much to learn about the complex phenomena that occur when fluoride acts to prevent dental caries. Among these are: the effects of fluoride on solubility, the processes that take place during topical fluoridation, the variables that control the formation of organic deposits on the teeth, details of the effect of fluoride on microorganisms and on the metabolism within dental plaque, the distribution and forms of fluoride present in plaque and oral tissues, the role of calcium fluoride in providing protection against caries, the role of dental plaque as a possible reservoir of fluoride, the effects of fluoride on the relative rates of remineralization and demineralization of enamel, the reactions between fluoride and enamel mineral both before and after tooth formation, and the role of fluoride in preventing root surface caries. It was generally agreed that these phenomena are much more complex than has been assumed in the past and are still incompletely understood. It was also agreed that the continued presence of fluoride in the mouth is a desirable goal and that research directed toward this prevention strategy should be actively encouraged. It is the hope of the National Caries Program that the reader will be cognizant of the questions present here and contribute to their solution.

On behalf of the National Caries Program, I thank all the participants for their important contributions. Particularly, I wish to thank the authors who prepared their manuscripts for early distribution to all participants, the moderators for also leading the task groups in preparing summaries and recommendations for future research, the editors, Drs. Walter Brown and Klaus König, for completing their task so promptly, and Mrs. Marion Kumpula for her excellent handling of the complex administrative details. Special recognition is also due to the planning committee, Drs. Walter Brown, Rachel Larson, Israel Kleinberg, and John Weatherell for designing the well-balanced agenda and contributing generously to the editing. Dr. Raquel Halegua, Caries Grant Programs Branch, National Caries Program, National Institute of Dental Research, Bethesda, Md (USA)

Preface
Mechanisms of Action of Fluorides in Caries Prevention
J. P. Carlos
I am very pleased to initiate this series of discussions on the Mechanisms of Action of Fluorides in Caries Prevention and to welcome a truly expert assembly of our colleagues to deliberate on this subject. This is a conference which we have thought about for a long time and for which we have exceptionally high expectations. It is hard to imagine how we could have brought together any stronger array of scientific talent to debate the topic question.

I take a special and a personal pleasure in welcoming such a distinguished group of our foreign colleagues. The notion of National boundaries has no relevance to the caries research effort, but it is only occasionally that we are able to acknowledge that fact by bringing together researchers from several countries who share a common interest and a common expertise.

Many of our foreign guests belong to ORCA, an organization which has had profound influence on caries research and prevention throughout the world. Members of ORCA have done pioneering work on fluorides and, it is fair to say, are largely responsible for the fact that the use of topical fluorides in public health programs in Europe has generally advanced more rapidly than in the USA.

I cannot take the time now to welcome each of you personally, but I do wish to recognize the President of ORCA, Prof. Y. Ericsson, and the Secretary General, Prof. L. Hardwick, and to tell you, Yngve, and you, Leslie, how pleased I am that you, and our other colleagues and friends from overseas are with us for this conference.

It seems to me that, from a scientific standpoint, this workshop is several years overdue. As pragmatic successes in preventing caries with both water fluoridation and topical fluorides have been achieved, research interest in the biologic bases for these results has seemed to wane – a trend that only recently appears to be reversing.

Fluorides have been, and still are, the single most effective weapon in our still limited arsenal of anticaries agents. Yet, even at best, fluorides have resulted only in partial and temporary protection from the disease. Many explanations for this are possible. Yet, our incomplete knowledge about how this ion exerts its protective effects continues to be an embarrassment and a scientific challenge to us all. The question is not simply academic Far from it! It is extremely doubtful that we will devise more effective therapeutic uses of fluorides by further empirical manipulation of compounds or treatment schedules. If fluorides have greater public health potential, that potential will be reached only by sounder therapeutic rationales based upon more complete understanding of the mechanism of fluoride action – or, more correctly, actions, since it becomes increasingly likely that we are dealing with a whole array of mechanisms, depending upon the circumstances.

In a much-quoted paper, Lewis Thomas [1973], President of the Sloan-Kettering Cancer Center, distinguishes between ‘high-technology’ and ‘half-way technologies’ in modern medicine. High technology is the ultimate result of the marriage between biology and therapeutics, in which disease prevention is based upon nearly complete understanding of disease causation. These technologies, though highly sophisticated, are relatively inexpensive to apply. Examples of ‘high technologies’ are immunization against diphtheria and dietary prevention of certain nutritional disorders. Clearly, we do not yet have high technologies to deploy against dental diseases.
Rather, most of dental practice consists, in Thomas’ [1973] terms, of ‘half-way’ technologies; expensive, stopgap measures applied after the fact of disease occurrence to, at best, lessen its impact on the affected public.

It seems correct to describe the purpose of dental research as an effort to create a ‘high technology’ to prevent and control oral diseases. In caries research, we are moving perceptibly closer, but we still have far to go. Meanwhile, we have to beware of the danger of promising practitioners and the public better developed technologies than we are yet prepared to deliver.

In theory, we already know how to prevent caries completely. Furthermore, all of us can cite specific cases in which theory has been successfully translated into practice with individual patients. But to infer from these facts that the public health problem of caries is solved, is to promote, in Mühlemann’s [1970] words, a ‘cruel illusion’; and one which ignores the real-world parameters of economics, delivery systems, and public priorities and motivations.

We have, one hopes, by no means exhausted the possibilities with fluorides, not to mention the many other potentially effective methods of prevention now being researched. Hopefully, our discussions here will re-stimulate efforts in this direction.

How close are we to a full understanding of the action of fluorides? That, ladies and gentlemen, remains the central question. Whatever the answer, I am confident that, by Sunday noon, we shall be closer than we are tonight.

I must extend sincere thanks to those who have worked so hard to organize this program: Walter Brown, John Weatherell, Israel Kleinberg, Rachel Larson, Raquel Halegua and Tom O’Brien. Well done!

I look forward to a stimulating, provocative workshop and, once again, welcome – all of you.

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