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Scope of Study: During recent years evidence has been accumulating on the advantages of adding fluorides to public water supplies as a means of preventing dental caries. The U. S. Public Health Service is cooperating with cities in conducting studies to determine how fluorides prove beneficial in reducing caries. The first such projects started were at Grand Rapids, Michigan and Newburgh, New York, where studies were begun in 1945. The results of such studies as these are included in this report. Criticisms most commonly expressed by the public which defamed fluoridation are presented along with scientific facts which refute these assertions. Some suggestions and recommendations are included as to how these problems may be solved educationally through a dental health program.

Findings and Conclusions: After some twenty years of research, experimentation and controversy, fluoridation is spreading so rapidly across the country today that the best-informed people cannot keep track of its progress. Although studies are still being conducted to determine the greatest amount of protection that may be realized from fluoridation, there is ample evidence to justify its use in any community where the water supply is deficient in fluorides and where the standards established by the state and local health authorities can be met. There is evidence that the beneficial effects of fluoride bearing water are obtained only after several years of continuous use. Fluoridation is not a cure all. On the otherhand, when one realizes the average child today faces the grim prospect of losing almost five teeth from decay by age twenty-one and, in nine mouths out of ten, bridges, partial or full dentures will be necessary by age thirty-five, and with dentists being able to provide only a fifth of today's needed dental service, the conclusion is foregone. Prevention, such as fluoridation projects, is our only solution for oral health.

ADVISER'S APPROVAL James H. Zant

A SUMMARY OF STUDIES AND CRITICISMS OF WATER FLUORIDATION

By

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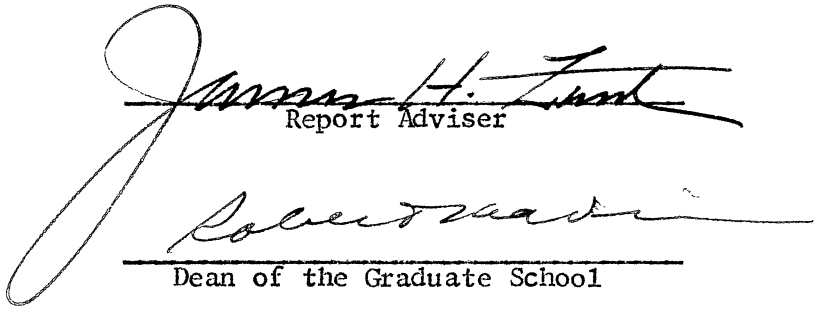

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PREFACE

Nearly every decade of the past century has marked a milestone in the progress of public health. Milk pasteurization, water chlorination, anesthesia, the antibiotics, the Salk vaccine, are only a small number of the list of successes. Water fluoridation, for the partial prevention of tooth decay, deserves a prominent place in any such listing of public health achievements.

Tooth decay is one of the most prevalent diseases of civilized man and of great importance from the standpoint of both the individual and public health. Very few persons now escape its attacks. It begins in early childhood and usually continues until most teeth have been affected. Progress is being made toward the control and prevention of dental caries by general means rather than by simply repairing damage already done.

Evidence has increased, mostly during recent years, that fluorides in limited amounts occurring naturally in domestic water supplies during the period of the development of permanent teeth in children does inhibit tooth decay. We are gratified by the findings because the national pattern shows future results that will be even more significant.

The writer has observed results of fluoridation and is definitely convinced without a shadow of a doubt that this is our only solution for preventing dental caries. As a former dental assistant, interest has accumulated over a period of several years and special thanks is due to D. C. Pennington, D. D. S. for culturing this interest as well as his enthusiasm and contributions. Indebtedness is acknowledged to H. Roy

Gravelle, D. D. S., Director of the Division of Preventive Dentistry, Oklahoma State Health Department, for his guidance, technical assistance and information concerning the Oklahoma studies, and to the American Dental Association, Oklahoma State Department of Health and Oklahoma State Dental Association who supplied the necessary data and literature which made this report possible. The acknowledgements would not be complete without giving credit to Dr. James H. Zant, Director of the National Science Foundation Program, for his helpful guidance and suggestions.

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CHAPTER I

HISTORICAL BACKGROUND

In the United States studies started in 1908 of a condition known as "Colorado brown stain" laid the foundation for the discovery of the decay preventive value of fluorides in drinking water.

In 1916 two scientists reported "a curious absence of decay" among residents in areas where we now know fluorides were present in the drinking water. However, not until 1931 was it proven that the effective element in the drinking water was the fluoride ion. The presence of some 8,500 articles in the scientific literature today attests the vast body of knowledge collected about the fluorides. By 1940 it was proven that insofar as the fluorides are concerned there are about three types of drinking water: Those deficient in fluorides, waters with the optimum concentration, and those with excessive amounts of fluoride. Dental decay is extensive in communities using low-fluoride or fluoride-free water while people using drinking water containing the correct amount of fluoride have about two-thirds less tooth decay. The use of water with excessive fluorides results in discoloring or mottling of the teeth. These ranges of fluoride concentration are well within the control of the water plant operator.

By fluoridation we mean the adjustment of the fluoride content of a water supply to a level which reduces the incidence of tooth decay. This optimum concentration is very low, one part of fluorine for each million

parts of water in most areas of the country. Sodium silicofluoride, sodium fluoride, and hydrofluosilicic acid are the most commonly used fluoride compounds. These are fed into the water by equipment similar to that used for years to add chemicals such as chlorine, alum, or lime.

Water-borne fluorides are not something new in the United States. Over sixty-five million people for years have used water containing fluoride naturally, 4,500,000 of these drink naturally fluoridated water containing 0.7 or more parts of fluorine per million parts of water. Although one part fluoride to each million parts of water (ppm) is the recommended concentration, many thousands of people for years have used water containing three times, five times, and even seven or more times this amount. Examples of these communities include Thomaston, Alabama, which uses water containing 3.2 ppm; Bureau, Illinois, 5.5 ppm; Langford, South Dakota, 8.0 ppm; Gabbs, Nevada, 8.7 ppm; Gillette, Wyoming, 4.0 ppm; and Bartlett, Texas, 8.0 ppm.[1]

Years of study and research are required before a health measure, such as fluoridation, can be recommended with safety. The dental benefits of fluoridation have been thoroughly explored. The research work has been painstaking, yet no scientist has been able to find any harmful effects from fluorides in the amount recommended for protection against dental decay.

Fluoridation is the most practical and effective public health measure for the prevention of dental decay; however, it does not treat decay that has already started. Fluoride is not a medicine, not a cure-all, but an important dietary factor during the time teeth are forming.

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[1]Frank E. Law, "Water Fluoridation - A Positive Health Protection" California's Health (September, 1956), GP O 917470.

Fluoridation of drinking water has emerged as one of the outstanding public health developments of recent years. It will take its place in history with other public health achievements.

CHAPTER II

FLUORIDATION STUDIES

Dental disease, the most common disease of mankind, begins soon after teeth first appear in the child's mouth and continues to be a major problem throughout life. The importance of dental health in maintaining physical and emotional well-being is recognized by all.

Dental defects are a major school health problem and lead the list of uncorrected defects. Examinations of school children last year in one large city disclosed that 75 per cent had dental defects.[2] A recent survey in a western state disclosed that over one-third of the six-year-olds, three-fourths of the seven-year-olds, and practically all of the nine-year-olds had been attacked by dental decay.[3] Considerably less than half the total needs for dental care in children are being met. These untreated needs of childhood carry over into later life so that by age forty about one-fourth of the people have lost all of their teeth.

For a good many years the growth of the dental profession has not kept pace with the population increase in this country. It seems quite unlikely that, in the foreseeable future, there will be enough dentists to care for the dental needs of our population. The only practical solution to this problem lies in the prevention of dental disease.

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[2] Ibid.
[3] Ibid.

There very definitely is a health problem and fluoridation seems to be the universal solution for preventing dental caries. First, a knowledge of the tooth structure is necessary so that the effects of fluoride on the enamel will be understood.

A tooth is a hard, calcified structure. It has been suggested that fluorine exists in the teeth in the chemical form of apatite, with the fluorapatite molecule being composed of calcium and phosphorous with a fluorine link.[4] If in bone formation, vitamins C and D are required for the proper laying down of calcium phosphate, it is quite conceivable that the same vitamins are necessary for the laying down of fluorapatite in the dental enamel.[5]

The reduction of caries activity suggests that enamel is capable of adsorbing this substance. Studies by Armstrong, indicate that caries-free teeth contain more fluorine than carious teeth.[6]

Fluorine must, apparently, be incorporated in the dental enamel to be effective, since it is necessary to ingest the fluorine during the period of tooth development, or to have it applied to the surface of the tooth repeatedly in rather concentrated solutions, resulting in an adsorption of the fluoride by the enamel. It is recommended that treatments be given at the approximate ages of three, seven, ten, and thirteen, so that all the teeth will be treated soon after they erupt.

The fluoride must function in one of two ways. It either modifies the tooth structure in a manner that confers upon it a degree of immunity

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[4]Lyon P. Strean and Jean P. Beaudet, "Dental Caries Inhibited by Fluoride-Vitamin Tablets." Dental Survey, Vol. 22, (April, 1946), pp. 689-691.

[5]Ibid.

[6]Philip Jay, "Fluorine and Dental Caries." Journal of American Dental Association, Vol. 33, (April, 1946), pp. 489-495.

to caries attack or else it serves to mitigate the potency of the attacking force itself.[7]

Since the presence of fluorine does render highly mineralized substances less soluble, it has been suggested that teeth rich in fluorine decay less readily than teeth deficient in fluorine because they are able to resist the acids which ordinarily produce tooth cavitation.

Findings in the epidemiological studies of dental caries has been the very low frequency of high saliva Lactobacillus counts in fluoride areas.[8]

How the fluorine operates to inhibit oral Lactobacilli, and very likely other bacteria which inhabit the mouth, is still a matter of speculation. Since fluorine is not excreted in the saliva, the action is not direct. A possible explanation is that trace amounts of fluorine on the oral surface of the enamel influence the character of the bacterial plaques on the teeth.

The fluorine must come directly in contact with the bacterial flora of the tooth in order to prevent caries activity. Fluorine is an enzyme inhibitor and, when it is present in sufficient strength, inhibits bacterial growth and acid production in the test tube. Whether the fluorine in dental enamel exerts a similar influence in the mouth is not known.

The powdered tooth substances used in the laboratory presents a surface which has had little exposure to the environmental condition of the mouth. In this respect it is comparable to the surface of a freshly-erupted tooth rather than that of an adult tooth which may have undergone a partial replacement with organic material or may have already reacted

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[7] Ibid., p. 488.
[8] Ibid., p. 491.

with a variety of ions such as lead, zinc, or iron.[9]

Thus we can postulate that the freshly-erupted tooth surface, (and to a large degree, freshly-powdered, tooth substance) offers an "immature" or "chemically unreacted" surface which under ordinary circumstances is a relatively soluble hydrozyl apatite and anything which reacts with it to form a less soluble apatite or phosphate complex will increase the resistance to dental caries.[10]

The foregoing hypothesis can explain why fluoride treatments have been effective only in children. The results of clinical studies in children indicate that there is a fairly direct correlation. The results in adults however, show no such relationship. So, the importance of early (almost pre-natal) fluoridation is necessary.

To gain the full benefits of fluoridated water, children must drink it during the period their teeth are forming, or from birth to about age eight.

The caries-preventive effect of adequate fluoride intake is principally conferred upon children up to about the twelfth year of life, during the period when dentine and enamel of the permanent dentition are being formed. This increased resistance to dental caries is carried over into later life to an appreciable degree. The results of experimental studies conducted in the laboratory give consistent support to the concept of the inhibitory effect of fluoride on the caries process. The level of fluoride concentration in drinking water which is associated with the appearance of

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[9]B. G. Bibby, "Use of Fluorine in Prevention of Dental Caries. A Consideration of the Effectiveness of Various Fluoride Mixtures." Journal of American Dental Association, Vol. 34, (January, 1947), pp. 26-32.

[10]Ibid.

mottled enamel varies with individual susceptibility and with the amount of water consumed. The upper level of safety has been reached in the northern part of the United States in domestic water supplies containing approximately 1.0 to 1.5 ppm fluoride, and in the southern part of the country approximately 0.7 ppm. Progress reports in several communities in which sodium fluoride has been added to the water supplies of low fluoride content indicate that this procedure will reduce the caries attack rate in children. There is evidence to suggest that it will confer an appreciable measure of protection to teeth of adults.[11]

In 1945 and 1946 several studies, each independent of the others, were begun to determine the effectiveness of and the problems involved in adjusting the fluoride concentration of a community water supply which was deficient in this element. Some of these study cities were Grand Rapids, Michigan; Newburgh, New York; Brantford, Ontario; Evanston, Illinois; Marshall, Texas; Sheboygan, Wisconsin; and Lewiston, Idaho.

The Grand Rapids study which is one of the better known pilot studies will be briefly discussed here.

The Grand Rapids study has shown that children born since 1945 and raised on the fluoride water have received the greatest benefits, about 65 per cent less tooth decay than children of the same age prior to fluoridation. The children born before the water was fluoridated obtain less, though significant, reductions in tooth decay. For example, children who were seven years old when water fluoridation was instituted and used this water until they were sixteen years of age have nearly 30 per cent

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[11] M. C. Winternitz, "Report of the Ad Hoc Committee on Fluoridation of Water Supplies." National Academy of Sciences - National Research Council, (Publication 214, 1952), pp. 5-6.

less decay than sixteen-year-olds who never used fluoride water. This same pattern of reduction in dental decay in the several age groups was present in Grand Rapids, Michigan, after ten years of water fluoridation.[12] These observations have been substantiated by similar findings in the other independent studies mentioned on the previous page. Data from these study cities indicate that continuous users of water to which the optimum amount of fluoride has been added have the same pattern of lowered tooth decay rates found in those using natural fluoride water under similar conditions.

Bringing the studies closer to home, the Oklahoma results were found to be comparable with the findings of the ten year study of Grand Rapids. A more detailed summary of the Oklahoma findings will be cited.

Fluoridation of the water supply in three Oklahoma communities has definitely reduced tooth decay among school children, according to studies made since 1953.

The State Department of Health reports that children in elementary grades in Bartlesville, Nowata, and Clinton were examined before fluoridation of water, and again more recently, in October, 1956, to measure the effects of the water treatment.

Only native born boys and girls were tested, as any children moving to the three cities may have come in contact with fluoride before coming to Oklahoma, and conditions would not be comparable.

Bartlesville tests made in April, 1953 showed .46 cavities per pupil examined in the first grade. The 1956 tests, after fluoridation, indicated .25 cavities per first grade child. This means that in 1953 each child

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[12] Ibid., p. 3.

had about one-half cavity, and in 1956 one-fourth cavity, about a 50 per cent reduction.

The 1953 second grader had an average of 1.03 cavities, but the 1956 second grader had only .5 cavities, a 51 per cent reduction.

Today's third grader has .87 cavities compared with 1.36 before Bartlesville fluoridated its water. The 1953 third grader, now in the sixth grade, has 2.41 cavities, compared with 2.95 for a sixth grader before fluoridation, an 18 per cent reduction.

Today's fourth grader has 1.18 cavities compared with 2.03 in 1953, a 42 per cent reduction. The fifth grader's cavities have been reduced from 2.95 to 1.83, a 38 per cent reduction, and the sixth grader's from 2.95 to 2.41, an 18 per cent reduction.

Nowata tests made in 1953 showed .27 cavities per pupil in the first grade compared with 1956 tests showing .04 cavities per pupil, an 85 per cent reduction. The 1953 second grader had .61 cavities, and the 1956 second grader had only .47 cavities, a 23 per cent reduction.

Other findings from Nowata are: Today's third grader has .81 cavities compared with 1.33 before fluoridation. Today's fourth grader has 1.07 cavities compared with 1.90, a 44 per cent reduction. The fifth grader's cavities are reduced from 2.28 to 1.42, a 38 per cent reduction. The sixth grader's, from 3.37 to 1.63, a 52 per cent reduction.

The survey was begun in Clinton in March, 1954, and first graders then showed .57 cavities per pupil, with a decrease to .27 in 1956, a 50 per cent reduction. The second graders had 1.10 cavities, and in 1956 only .68 cavities.

Findings from Clinton also showed: Today's third grader has .91 cavities compared with 1.34 before fluoridation. The 1954 third grader,

now in the sixth, has 1.89 cavities, compared with 3.60 for a sixth grader before.

Today's fourth grader has 1.45 cavities compared with 1.88. The fifth grader's cavities have been reduced from 2.64 to 1.36, and the sixth grader's from 3.60 to 1.90.[13]

Other Oklahoma cities which fluoridate their water are Guthrie, Altus, Oklahoma City, Ada, Tulsa, Ponca City, Tonkawa, Ardmore, Kingfisher, and Mangum. Sulphur and Stillwater plan to fluoridate in the near future. There are forty-nine state cities which have natural fluorides in their water.

These cities report every thirty days to the State Department of Health as required of all municipal water supplies, according to Dr. Roy Gravelle.

A study of adults in two Colorado cities proves that the beneficial effects of fluoride water, accrued during childhood, continue into the older age groups. Boulder, Colorado, uses a fluoride-free water supply while the water supply of Colorado Springs contains 2.5 parts per million of fluoride. In Boulder, forty to forty-four year-old persons had twenty-two teeth which had decayed, while the same age groups in Colorado Springs averaged less than half (ten) as many teeth attacked.[14] On comparing the tooth decay rates in these two cities from age twenty to age forty-five, it is noted that the decay pattern established in childhood has continued into these older ages. It was found also that the forty to forty-four year group in the fluoride-free city averaged five times as many missing

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[13]H. Roy Gravelle, "Fluoridation of Water Supply Cuts Decay for State Pupils," Oklahoma Health Bulletin, Vol. 15, (January, 1957). p. 1

[14]Frank E. Law, p. 2.

teeth as their counterparts who had used fluoride water all their lives.

The use, for many years, of natural fluoride waters by a large part of our population afforded excellent opportunities to study the effects of such water on human health. One of the first discoveries in this natural laboratory was that developing teeth are very sensitive to excessive water-borne fluorides, so that mottling occurs. No other clinically significant physical effects have ever been found even at these high concentrations of fluoride.

The Public Health Service conducted a study on people born and raised in Cameron and Bartlett, Texas. The Cameron water supply contains naturally 0.4 parts of fluoride per million while in Bartlett the water supply contains twenty times that amount, or 8.0 parts per million. Reports were made on laboratory, x-ray, medical, and oral examinations conducted in 1943 and in 1953. Those examined in Bartlett averaged over thirty-six years' use of the high fluoride water. A variety of characteristics in the two groups were compared, including arthritic changes, cardiovascular conditions, hearing loss, bone changes, eye conditions, occurence of tumors or cysts, fractures, blood pressure variations, thyroid abnormalties, kidney stones, and gall stones. Laboratory findings in the blood and urine were also studied and compared. It was found that no clinically significant physiological or functional effects resulted from the prolonged ingestion of water containing excessive fluoride except for mottled enamel.[15]

To this day not one piece of scientific evidence has ever been

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[15]Eugene R. Zimmermann, Nicholas C. Leone, and Francis A. Arnold, "Oral Aspects of Excessive Fluorides in a Water Supply." Journal of the American Dental Association, Vol. 50, (March, 1956), pp. 272-281.

presented to prove that water fluoridated at the recommended level is harmful to health. Then fluoridation is safe!

CHAPTER III

CRITICISMS AND ANSWERS

Many of the statements which recur in the literature are so fantastic that they do not merit serious consideration. A brief summary of a typical cross section of the material reveals that most of the arguments fall into a common pattern, and the following facts may be used to refute the more common ones.

It has been suggested that fluoride compounds be added to milk and other foods, that food be grown on soil rich in fluoride, that cows be fed fluoride enriched feeds, and that drinking water be fluoridated in the home. In the light of present knowledge, such schemes are impractical when compared with the simplicity and low cost of fluoridating the public water supply.[16]

The principle of water fluoridation does not necessarily hinge on the ingestion of a definite quantity, for example, one milligram, of fluoride per day but rather derives from the observation that the presence of one or more parts per million of fluoride ion in domestic water is associated with substantially reduced caries rates.[17] Such water is used in locally manufactured beverages as well as in cooking and for drinking. Fluoride is thus consumed throughout each day by every child living in

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[16] "Better Health for 5 to 14 cents a Year Through Fluoridated Water." Public Health Service Publication No. 62, (Washington, 1951), p. 7.

[17] H. T. Dean, "Fluorine: Water-borne Fluorides and Dental Health." Dentistry in Public Health, (Philadelphia, 1949), p. 136

the community. If fluoride were available only in dairy milk, many infants would receive little or none in the first weeks of life, growing children would obtain it to varying degrees depending on their individual liking for milk, and older children, whose dietary habits are frequently improper, would receive an indeterminate quantity of fluoride at a time when their teeth are still undergoing active formation. It should be added that many children consume relatively large quantities of milk.

There would be the additional problem of deciding on the actual amount of fluoride that would have to be added to milk to ensure an intake of fluoride that might produce effective results in controlling caries. The intake of water, though it may be somewhat irregular, is less variable than other items in human nutrition. Nuckolls has pointed out also that the average individual does not consume water beyond the normal metabolic requirement and that excessive amounts of fluoride are not likely to be ingested when the mineral is provided through this medium.[18]

In communities where fluoride is added to the water supply, the output is regulated automatically which is reliable and requires a minimum of attention. In a dairy, however, the chemicals would frequently have to be added to individual vats of milk, and rigorous vigilance would be necessary to ensure that the concentrations would remain constant from batch to batch. The chemical determination of fluoride in milk is much more difficult and involved than the determination of fluoride in water.

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[18] News Letter, Council on Dental Health, American Dental Association, (June 9, 1952), p. 3.

There are more than twelve million people in various areas of the United States who are already using water supplies containing optimal or more than optimal amounts of fluoride.[19] If fluoridated milk were used, it would be necessary, in order to avoid the possibility of producing mottled enamel, to ensure that the fluoridated milk would not find its way into these areas.

In consideration of the low price of chemicals and the limited technical attention required for continued operation, fluoridation of the water supply is actually the least expensive and most convenient method known for caries control. If fluoridated milk were made available at even a fourth of a cent per quart above the regular price (a low estimate for the cost of chemicals, chemical control procedures, advertising, labeling and distribution), the annual cost per consumer, on the basis of one quart per day, would be about ninety cents.[20]

Experiment and investigation may, after many years, reveal whether or not fluoridated milk may be useful in the control of dental caries. At the present time it does not appear promising. Until an accumulation of scientific data indicates the usefulness of other procedures, the current method utilizing fluoridation of domestic water supplies offers the only established means of reducing the incidence of dental caries on a popular basis. Untested alternatives, such as the use of fluoridated tablets, table salt, chewing gum, dentrifices, mouthwashes, bottled water or milk, should not be advocated, since the true issue tends to become

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[19] W. P. Phair and M. F. Driscoll, "The Status of Fluoridation Programs in the United States, its Territories and Possessions." Journal of American Dental Association, 45:555, November, 1952.

[20] Sholom Pearlman, "Untested Alternatives to Fluoridation of Domestic Water Supplies." Journal of American Dental Association, Vol. 46, (March, 1953), pp. 287-289.

clouded in the resulting confusion.[21]

It is wasteful to fluoridate all the water when only a small amount of it is used for drinking purposes.

Treated water, the treatment including chlorination, softening and other processes, is used also for watering lawns, washing cars and for most industrial purposes, yet it has been found much more practical to treat the entire water supply than to have separate water systems. The same is true of water fluoridation, particularly in view of the fact that the annual cost per person will average about nine cents, and this amount covers fluoridation of all the water, not just that used for drinking purposes.[22]

Fluoridation is compulsory medication in that everyone is compelled to drink the fluoridated water.

Again, fluoridation is not medication. Fluoridation does not mean compulsion on the part of individuals any more than does the use of other community resources, including chlorinated water. People form communities so that they can share such common public services as schools, fire departments, water supplies and libraries. If a separate group in the community wants a school that is different from that chosen by the majority, then it establishes its own. The same principle applies equally to the water and milk supplies. If a community wants its water fluoridated and its milk pasteurized, then fluoride-free water and unpasteurized milk can be obtained outside the community.

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[21]"Current Status of Dental Uses of Fluorides." Journal of American Dental Association, 45:468 (October, 1952).

[22]Answers to Criticisms of Fluoridation, American Dental Association, G21-50M-3-56, (April, 1956), p. 8.

Another writer expresses it this way: The purpose of medication is the cure of disease in some form. Fluorides are not added to water for therapeutic purposes, namely, to treat or to cure a disease. They constitute the only preventive tool. Fluorides do not cure dental caries. They perform a much more important service in that they help nature to build more resistant teeth.

Fluoridation consists of merely a process of supplementation, adjusting a normal constituent of most natural waters to its optimum content from the standpoint of public health. Obviously, since fluoridation is not medication, it cannot be considered the practice of socialized medicine.[23]

It may be pointed out in addition that it would be a travestry of the democratic process of free choice if a minority of misguided but militant partisans were to be permitted to prevent the majority of the population from choosing to obtain relief from dental disease by the simplest, cheapest, and most effective method available.
An accident in the water plant might cause over-dosage and severe harmful effects.

Acute morbidity manifested by increased salivation and vomiting may be caused by ingesting 0.25 grams of sodium fluoride. This quantity in an eight ounce glass of water represents 1,000 ppm sodium fluoride, or about 450 ppm fluorine. To obtain this concentration, it would require more than four tons of sodium fluoride per million gallons of water

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[23]A. P. Black, "Facts in Refutation of Claims by Opponents of Fluoridation." Journal of American Dental Association, Vol. 50, (June, 1955), pp. 655-664.

processed which is obviously not possible in a program of water fluoridation, even if gross negligence occured.[24]

Through just one twist of a valve, an enemy could flood the city with poisonous fluorides and kill off the whole population.

This statement has appeared in several newspapers. Considering the answer to the previous statement, it seems hardly likely that saboteurs would attempt to rely on tons of sodium fluoride when one ounce of botulinus toxin in a reservoir of water would have much greater effect.

The statement that fluoridation means adding a poison to the water supply, which has sometimes been facetiously termed "operation rat poison", recurs very frequently and is the type of statement calculated to inspire fear in the minds of the great body of consumers who are not able to check the facts themselves. Again and again, in the antifluoridation literature, the properties of the fluoride salts are confused with those of gaseous fluorine. It is true that all of the compounds presently used for the fluoridation of water have long been known as poisons, when ingested in massive doses. However, the same statement is true of a great many of the materials with which every one comes in contact in their daily lives. The chlorine used for water sterilization, the alum used for water coagulation and the quick-lime and soda ash used for water softening are all corrosive poisons when ingested in massive doses. Both the spirits of ammonia and tincture of iodine, found in almost every home medicine chest, are corrosive poisons. Many of the medicines routinely used for the cure of diseases are deadly poisons when taken in suffi-

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[24]Charles R. Cox and David B. Ast, "Water Fluoridation - a Sound Public Health Practice." Journal of American Water Works Association, 43:641, August, 1951.

cient doses. The truth of the matter is, of course, that when one characterizes a substance as "poison", one must specify the conditions under which it is used.[25]

The American Water Works Association has given assurance that the procedure for fluoridation is no more involved than that for other chemicals that are routinely added to the water for purification. Fluoridation does not affect the taste, the odor, or the color of water. Fluoridation does not add hardness to water. Fluoridation does not affect the use of water for any domestic or industrial purpose.[26] Most of the "medical" arguments against fluoridation are based on the layman's frightened misconceptions stemming from the fact that, in high concentrations, fluorine is used as a poison in rat exterminators and insecticides.

Actually, in the greatly diluted amounts used for reservoir treatments, the body takes in an estimated 0.5 to 1.0 milligram. It could handle 4.0 to 5.0 milligrams daily with safe and practically complete excretion.[27] Since fluorides also are used by industry as "hardening" agents, it has been charged that they would similarly "harden" the human arteries. In industry and physiology, the word "harden" has entirely different meanings.

Why, the proponents ask, don't those who fear the "poisonous" fluorine also object to chlorination, since chlorine can be made into one of the worst poison gases? Even more dangerous, how about mixing

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[25]A. P. Black, Ibid., pp. 655-664.

[26]Why Your Dentist Recommends Fluoridation, G2-250M, American Dental Association, (January, 1956).

[27]Henry Lee, "A Sure Way to Reduce Tooth Decay." Pageant, (May, 1953).

sodium, a highly reactive substance, with chlorine to form sodium chloride? All of you know the dreadful result-ordinary table salt.

The statement that fluoridation violates personal rights or religious freedom is employed, probably more than any other, by the opponents of fluoridation. The first five court decisions on fluoridation were rendered in 1952. They were in Northampton, Massachusetts; San Diego, California; Chehalis, Washington; Baltimore, Maryland; and Fargo, North Dakota. In all five cases, fluoridation was upheld by the court, and in these, except the Northampton case, the main issue presented was the contention that fluoridation violates the fourteenth Amendment to the Constitution, which indirectly protects persons from an invasion of their religious freedom by action of state and local governments.[28]

A discussion of all five of these cases by two outstanding New York attorneys may be found in the April, 1953 number of the Journal of the American Water Works Association.

Costs are going up all the time, and the city cannot afford to add another item to its budget.

Its cost is insignificant, from five to fourteen cents per inhabitant yearly, so that over his lifetime, each person will spend about seven dollars. Since he gets many times as much dental protection as the person who drinks fluoride-free water, the American Dental Association asserts flatly that no community now can afford to continue with untreated supplies.[29] The cost of water fluoridation will vary among communities according to local differences in water supplies, industrial use, types of equipment, and the chemical used. Compared with the cost of other compounds used in

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[28]A. P. Black, Ibid., pp. 655-664

[29]Henry Lee, Ibid.

water treatment the cost of fluoridation is very nominal. In one large city the cost of controlled fluoridation using sodium silicofluoride is $1.36 per million gallons of water. Another city using hydrofluorsilicic acid averages $1.03 per million gallons of water. By comparison in these two cities, the average cost per million gallons for alum was $8.49 and $4.73; for chlorine, $2.42 and $1.99; and for lime, $1.64 and $0.30, respectively.[30]

Surely there can be no doubt regarding the answer to the question on economy. Water fluoridation is very economical. Next, the question arises can this decay preventive be readily applied and controlled? The water engineering practices in controlled fluoridation are not particularly difficult. The various state health departments have established regulations governing the application of this procedure in local water plants. Usually the state authority reviews the installation plans and issues a permit to the water company. The regulations call for periodic testing at the water plant, samples are sent regularly to the state laboratory for check-testing and weekly or monthly reports on the amount of fluoride compound used and the volume of water pumped. The color reaction methods used in determining the fluoride concentration varies only slightly from those used for other water testing. Colorimeters, either visual or photoelectric, are available for these tests and are well within the required accuracy. As mentioned earlier, the equipment used in applying the fluoride compound to the water is not new to the water plant operator. Similar equipment has been used for years in water treatment.

Now, is the application legal? As it has with other public health

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[30]Frank E. Law, Ibid.

measures, the legality of water fluoridation has been questioned over the last several years. The legality of water fluoridation has been tested in the courts of thirteen states and in seven of these states - California, Louisiana, North Dakota, Ohio, Oklahoma, Washington, and Wisconsin - the cases were carried to State Supreme Courts. In the California, Louisiana, and Oklahoma cases appeals were taken to the United States Supreme Court which refused to review them. Fluoridation has been challenged most frequently as an unconstitutional invasion of individual liberties.

In no instance has fluoridation lost a final court action. It is a proper subject for community action. It is legal.

Fluoridation does not have the approval of the qualified health professions.

During the past several years the majority of national health organizations have endorsed water fluoridation as a safe and effective method for reducing the incidence of tooth decay. These national associations, representing the majority of dentists, physicians, and public health scientists in this country, did not give their approval lightly. The endorsements were given only after careful, detailed study of the evidence by special committees, competent members, and expert consultants. A partial list of these national health groups includes, the American Dental Association, the American Medical Association, the National Research Council, the Department of Defense, the United States Public Health Service, the American Public Health Association, the American Academy of Pediatrics, the American Hospital Association, and the Association of State and Territorial Health Officers. Practically all state and local medical and dental societies have given their stamp of approval.

In addition many national lay groups interested in the health and welfare of our citizens have endorsed this great public health procedure and a large majority of their state organizations have followed suit.

There are, of course, those who oppose fluoridation just as some people even now oppose water chlorination, milk pasteurization, and smallpox vaccination. The introduction of water chlorination forty years ago met with the same type of opposition and essentially the same arguments that are used today against fluoridation. The opposition makes all sorts of claims but have been unable to produce any evidence that fluoridation is in any way harmful.

Some other questions that are frequently asked are about dentifrices and chewing gum. Stated more specifically: Is there any dentifrice on the market that will prevent tooth decay? The chief purpose of a dentifrice is to aid in cleaning the teeth. Dental scientists are investigating the possibility of a dentifrice that will prevent tooth decay or other dental disease, but so far there is not conclusive evidence of such properties in any dentifrice.

Does gum chewing help or harm the teeth? Most commercial chewing gums contain sugar, which contributes to tooth decay. (A few gums are sold that are sugar-free.) The theory that gum chewing provides needed exercise for teeth and jaws is erroneous. The teeth themselves, being rigid structures, need no exercise. The question of the possible benefit of exercise for the muscles of the jaws is still unresolved.[31]

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[31]W. W. Land and E. K. Mosenthal, "Court Decisions on Municipal Water Fluoridation." Journal of American Water Works Association, 45:387 (April, 1953).

CHAPTER IV

DENTAL HEALTH EDUCATION

A dental health education program in the elementary school may go a long way toward building lifelong habits of good health for the teeth and mouth. In the school program, teachers and pupils together may develop educational activities based on the dental experiences of the children, eruption and shedding of teeth, their dental visits, and other dental contacts. Learning activities may well be directed toward such dental health practices as brushing the teeth immediately after eating, limiting the amount of sweets eaten, having routine examinations by the family dentist and obtaining topical applications of fluoride for the partial prevention of tooth decay if the pupils have not been drinking fluoridated water since birth.

Some children may be under dental supervision and school health programs will encourage them to continue. However, surveys indicate that many children, particularly those in the first and second grades, do not establish the practice of visiting the dentist on a routine basis.

When the school dental health program includes a dental inspection of all children, this part of the program will be effective only if parents cooperate by having a complete dental examination for the child by the family dentist and whatever treatment is found necessary. Parents must cooperate with teachers not only for the dental health but for the total health of the child.

How the individual may help the control of decay.

According to the United States Department of Agriculture, the average consumption of sugar per child in the United States is approximately one hundred pounds per year. In order to consume one hundred pounds of sugar per person during the year, a great many sweets would have to be consumed between meals, the most dangerous time as far as decay is concerned.

Sweets, when taken often, keep an almost constant supply of acid in the dental plaque which adheres to the surface of the teeth. This acid, formed two or three minutes after the sweet is introduced into the mouth may remain on the tooth for thirty to sixty minutes, dissolving its enamel.

Elimination of between-meal snacks of sweets will lessen decay by reducing the amount of acid formed in the dental plaques.

It does not seem consistent or reasonable for schools to teach the value of using less sugar, while at the same time candy, chewing gum, and soft drinks are indiscriminately sold in the school lunchroom and dispensing machines.

Correct toothbrushing will reduce decay. To be effective, brushing must be done immediately after meals. If this cannot be done, the mouth should be rinsed thoroughly with water after eating.

How the community may help the control of decay.

Dental services and the teaching of dental health should be an integral part of the community's health and educational program, because dental health is very important to the child's total health.

To attain these objectives, a community or school health council should be formed. More effective results are achieved by a group representing all community agencies interested in health. In general, they

should include representatives from classroom teachers, parent-teacher associations, local dental and medical societies, school administrators, members of boards of education, voluntary health agencies, local health departments, civic and service clubs, students, school physicians, dentists, nurses and dental hygienists.

Fluoridation is another safe and effective way in which the community can help control tooth decay. Any community can have fluoridation if the people so desire. The local health commissioner knows the procedure set up by the State Department of Health to obtain fluoridation. Fluoridation is not a cure all. It will not replace periodic treatment by the dentist. An adequate diet during the tooth-forming period, the restriction of sweets and proper toothbrushing are also necessary. Fluoridation will reduce new decay.

The council on Dental Health of the American Dental Association recommends that in areas where the drinking water is deficient in fluoride, topical fluoride treatment should be used routinely in private dental offices and in school and community dental health programs.

It is recommended that treatments be given at the approximate ages of three, seven, ten, and thirteen so that all the teeth will be treated soon after they erupt.

Clinical experience has shown that topical fluoride applications reduce the occurrence of dental decay by an average of 40 per cent. The results vary somewhat in individual children.

What can you do? Women's clubs, parent-teacher associations, civic and business groups, and other organizations are interested in bringing health protection to your community. You, as an individual can help by writing letters and cards offering your support to your city officials,

health department, dental and medical societies and other local organizations. You can help also by urging your own organization to take group action in bringing about the adoption of fluoridation.

Suggested Classroom Projects

Invite a dentist, dental hygienist or dental intern to the classroom to discuss informally with the class the use of diagnostic aids and new developments in the science of dentistry.

Sterilized extracted teeth may be obtained at most dental offices if time is allowed for the dentist to collect and sterilize the teeth. The dentist may cut the specimens in half to show structure.

Plaster models of mouths are available in many dental offices. These can be scrubbed with soap and water and used in toothbrushing instruction and the study of the shapes and names of the teeth. Children should obtain these models and demonstrate to the class with a toothbrush. Some dentists may even make models of children's mouths for classroom demonstration.

Most dentists will send the teacher some actual x-ray pictures showing the permanent teeth developing in the jaw bone. By examining these, children can see the position of the teeth.

Children may keep a diet list of everything that is eaten in one week. Compare the lists to charts or lists of foods that are harmful to the teeth. The teacher might suggest that the school dietician offer in the school cafeteria more substitutes for sweets such as nuts and raw fruit.

Illustrate how acids dissolve calcium from teeth. Place one tooth in ten per cent hydrochloric acid and another in plain water. Allow to stand for a week and show softening caused by acids.

Children may collaborate on a mouth health column for their school paper.[32]

Children may prepare and give a radio program on good dental health where there is a school radio system.

Television is another medium through which the public can be reached educationally. According to Dr. Roy Gravelle, this is being done in Oklahoma. We must reach the population as a whole and this is the most effective way of doing so.

A study of the school lunch program may provide an excellent way to bring in a discussion of the importance of diet to general health and dental health.

It is recommended that in elementary schools coke machines and candy machines be abandoned and milk and fruit machines be substituted in their places. This will help prevent caries and eliminate other dental diseases since children have a tendency to pass their coke on to a friend and share a bite of candy. Milk in cartons with straws and fresh fruit will not be shared so easily.

Demonstrate how an inexpensive, effective dentifrice can be made by mixing one part salt with two parts baking soda.

The writer is of the opinion that a child should be excused to keep office appointments with his physician or dentist during school hours. Many children are afraid of the dentist and, consequently, become maladjusted. As a psychological approach, leaving school may help eliminate this fear and less caries would be encountered in the long run.

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[32]Harvey C. Janke and Harry B. Millhoff, Dental Health Guide for Teachers. Ohio State Dental Association, pp. 28-29.

These are only a few of the projects that can be used to effectively teach dental health in the classroom.

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Report: A SUMMARY OF STUDIES AND CRITICISMS OF WATER FLUORIDATION

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