A Symposium

On June 22, 1892, Sir James Crichton-Browne, M. D., presided over the eastern counties branch of the British Dental Association in Cambridge. In the course of his remarks[1] he said:

"The late Dr. George Wilson showed that fluorine is more widely distributed in nature than was before his time supposed, but still, as he pointed out, it is but sparingly present where it does occur and the only channels by which it can apparently find its way into the animal economy are through the siliceous stems of grasses and the outer husks of grain, in which it exists in comparative abundance. Analysis has proved that the enamel of the teeth contains more fluorine, in the form of fluoride of calcium, than any other part of the body and fluorine might, indeed, be regarded as the characteristic chemical constituent of this structure, the hardest of all animal tissue and containing 95.5 percent of salts, against 72 percent in the dentine. As this is so it is clear that a supply

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The Dentist's Responsibility

Fluoridation of Municipal Waters

The Study of Mottled Enamel

By Frederick S. McKay, D. D. S.
Colorado Springs, Colorado

At the turn of the century dental pathologists recognized two principal developmental lesions of the enamel. Of the one most frequently occurring—then termed "atrophy"—the etiology was was fairly well understood. For the second, white spots in the enamel, there was no known explanation. In 1906–1907, the occurrence of an identical developmental lesion in practically the entire native population of Colorado Springs was brought to the attention of Dr. G. V. Black. Following a personal examination in 1910, he declared it to be a new lesion in dental pathology and gave it the name of "mottled enamel."

Widespread examinations of similarly afflicted populations showed that the one common factor apparently was the continuous use of the domestic water supply during the years of enamel formation. The waters associated with mottled enamel were derived from almost every conceivable source. However, it was found that

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A Chemist's Evaluation

By A. P. Black, Ph. D.
Head, Department of Chemistry
University of Florida

Fluorine, lightest and most active of a family of elements known as the halogens, was first isolated by the French chemist, Moisson, in 1886. It is not only the most active of its family, but is the most active element known, combining directly with all other elements except oxygen and the rare gases. Fluorine is present in most soils and in the bones and teeth of animals. Sea water contains approximately one part per million of the element, and it is present in amounts varying from mere traces to significant concentration in a high percentage of the public water supplies of this country. Fluorine is present in a great many of our human foods, although the average daily intake from food is quite small.

A chemist, H. V. Churchill, in 1931 first called attention to the fact that the water supplies of Bauxite, Ark., Colorado Springs, Colo., Kidder, S. Dak., Lidgerwood, N. Dak., and Oakley, Idaho, all known to produce mottling of teeth,

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of fluorine, while the development of the teeth is proceeding, is essential to the proper formation of the enamel and that any deficiency in this respect must result in thin and inferior enamel.

"If, in our dislike to grittiness, which has run parallel to our addiction to soft and succulent food and in our preference for white and fine flour, we have cut off the main source of supply of fluorine to our systems, it is not difficult to understand how we may have thereby incurred comparatively feeble and unprotected teeth, with a diminished power of resistance to adverse influences and peculiarly liable to decay. For the dense close-fitting prisms of the enamel are to the tooth what its armour plates are to a modern ship of war; and if they are easily penetrated, corroded, or worn away, then the fate of the dentine within is sealed. I think it well worthy of consideration whether the reintroduction into our diet, and especially into the diet of child-bearing women and of children, of a supply of fluorine in some suitable

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From the Annual Session of

The American Dental Association

The Practicing Dentist's Viewpoint

By Milton E. Nicholson, D. D. S.

Associate Professor of Public Health Dentistry
University of Pittsburgh

Fluoridation of municipal waters is now generally accepted as being one of the cheapest and most effective methods available for reducing the incidence of dental caries. Researchers, working independently of each other, have supplied us with so many findings in support of fluoridation that it seems almost basic for all communities to fluoridate their water supplies.

The practitioner can help further programs aimed at prevention and control of dental disease. He frequently does not realize just how important he is in helping to create public opinion. His close relationship with patients and his unique position as an accepted leader in dental health matters in the community enable him to guide dental health thinking of those with whom he comes in contact.

A number of far-sighted dentists and researchers have realized for years that the dental caries problem will never be solved by repair service alone. As a result, many preventive

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A Public Health Dentist's Viewpoint

By F. A. Bull, D. D. S., M. S. P. H.

Director of Dental Health
Wisconsin State Board of Health

To most of us in the dental profession the public health approach to the dental health problem is something new. The fluoridation program has given us the first opportunity to offer a preventative for dental caries which lends itself to mass control in 60 percent of the population.

No other public health program has had, at the time of its introduction, as much scientific data based on human experience. No valid disadvantage or objection to the program has been proved. Successful 5- and 6-year demonstrations in Michigan, New York, Wisconsin, Texas, and Canada were instrumental in bringing about national level approval of the fluoridation program.

But even when there is no real opposition to a public health program the "status quo" is a factor to be reckoned with. Hence, it is important that everyone concerned be given factual information about fluoridation and what it means in terms of improved dental and general

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Symposium

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natural form—and what form can be more suitable than that in which it exists in the pellicles of our grain stuffs?—might not do something to fortify the teeth of the next generation."

Today—nearly 60 years later—the vital role of fluorine is well established. First through topical applications and more recently by addition to public water supplies, the dentist, the public health worker, and the public now have at hand practical and effective measures for the large-scale prevention of dental caries in children.

Fluoridation of drinking water is emerging as one of the outstanding public health developments of recent years. Historians may well rank it with the control of typhoid fever, milkborne diseases, smallpox, and goiter. It represents both a remarkable research accomplishment and a major application of community health principles.

The first mass preventive measure in the field of dental public health, fluoridation requires not only the teamwork of dentists, chemists, engineers, and other public health people, but the active understanding and support of the public as a whole, their elected officials, and their community leaders. The growing number of communities—now more than 120, ranging from towns of 500 to metropolitan areas—which are bringing the benefits of fluoridated water to their children underscores the significance of this community health development.

The importance of fluoridation prompted the American Dental Association to include a symposium on "The Dentist's Responsibility in the Fluoridation of Municipal Waters" in the program for the 92d annual session, held in Washington, D. C., October 15–18, 1951. The four speakers were Dr. Frederick S. McKay, Colorado Springs, Colo., who was honored this year for his pioneering work in the field; Dr. A. P. Black, head of the Department of Chemistry of the University of Florida in Gainesville; Dr. Milton E. Nicholson, practicing dentist and associate professor of public health dentistry, University of Pittsburgh, Pittsburgh, Pa.; and Dr. Frank Bull, director of dental health, State Board of Health, Madison, Wis. The summary was given by Dr. Allen O. Gruebbel, secretary of the Council on Dental Health of the ADA.

By arrangement with the American Dental Association, the four major papers of the symposium are presented here in summary.

[1] Crichton-Browne, Sir James: An address on tooth culture. The Lancet, vol. 2, 1892, p. 6. Quoted by A. P. Black before the American Dental Association, October 17, 1951. Washington, D. C.

Dr. McKay

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very frequently the water in endemic districts came from drilled wells of varying depth.

Three strikingly similar experiences in towns in different parts of this country strengthened the water hypothesis and led directly to the discovery of the presence of fluoride. In two of these towns the domestic water supply had been changed from shallow wells to deep drilled wells; in the third town the change had been from shallow wells to water from a warm spring. In each instance mottled enamel became endemic in children born subsequently, whereas prior to the change the condition was unknown. H. V. Churchill, chief chemist of the Aluminum Company of America, found in 1931 that the fluoride content of the deep-well water at Bauxite, Ark., was 14 parts per million, an extremely high content which was reflected in the general severity of the mottled enamel in the population. Examination of water from other communities in which mottled enamel was endemic revealed fluorides. Similarly, water from communities in which there was no mottled enamel were found to be free of fluoride, or practically so.

It soon became apparent that invariably the caries experience rate among the natives of fluoride districts was remarkably low, even when the degree of dental fluorosis was pronounced or even extreme. The first examinations to determine this relationship were made in Wisconsin and other parts of the midwest by Bull, Dean, Arnold, and others.

The exhaustive and brilliant research conducted by Dean and co-workers over a wide territory not only confirmed beyond question the fluoride-low caries hypothesis, but also established that the safe and effective fluoride content is around 1 part fluoride in a million parts of water. As the fluoride content passes 1.5 parts

per million or approaches 2.0, the probability of producing a disfiguring fluorosis increases.

Studies in recent years indicate that the caries inhibitory action of fluoride extends well into middle life and that it is not necessary to continue the use of fluoridized water after the enamel has been calcified.

The average number of decayed, filled, and extracted teeth among the natives of fluoride communities is about three, at an average age of 25 years. And one third or more of the native persons are caries free.

During the decades of study by dentists and research workers to find a means of preventing the initial lesion of caries, the effort seemed to have concentrated on altering the environment of the teeth. On the contrary, the action of fluoride affects the structure or character of the teeth themselves. When caries occurs in fluorosed teeth it is virtually limited to the fissures and pits. Caries of the proximal surfaces of the anterior teeth is almost negligible.

In summing up, it can be emphasized that the integrity of the structure of the enamel is determined only during the period of calcification and not thereafter; fluoride is the only known agent ordinarily included in the diet that is capable of exercising a mass control of dental caries.

The practical application of the findings in this study has led us into the fluoridation of public water supplies, and the impact on public health and the future practice of dentistry cannot at present be completely evaluated.

Dr. Black

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contained fluoride. Though Churchill carefully stated that, because of the few samples examined, his work could not establish a definite correlation between the presence of fluorides and the production of mottled enamel, his report immediately focused attention on fluorides in water, and the connection quickly became apparent. Churchill asked what physiological effects may be produced by fluorides in water. The answer—the reduction of the incidence of dental caries—promises to be one of the landmarks in the history of public health, not only in this generation but in this century.

The first and still the most widely used material for fluoridation is sodium fluoride, which in its pure form is a white crystalline salt with a relatively high solubility constant over a wide temperature range. Because of its suitability for feeding in solution in small volumetric feeders, it is used in the majority of smaller installations throughout the country. A somewhat less expensive agent, used in larger installations, is sodium silicofluoride.

Dean reported in 1933 that fluoride concentrations of not more than 1.0 to 1.5 parts per million were not significant in the production of endemic dental fluorosis. Thus when the preventive effect of sodium fluoride became apparent, it was suggested that this dosage be used. A special committee of the American Water Works Association pointed out in 1949 that climatologic conditions might prove to be important since they govern to some extent the water intake of the individual. Evidence continues to accumulate, and it is now believed that a dosage of 0.7 part per million is sufficient to provide the necessary protection in regions where the mean annual temperature is above 70° F.

The mechanism of caries prevention is particularly difficult to determine, since the difference, if any, between the fluorine content of sound and carious teeth is very small. Armstrong and Brekhus have stated that the enamel of carious teeth contains less fluorine than the enamel of sound teeth. However, McClure has recently reported that the dentine and enamel of several hundred sound and carious teeth with no evidence of fluorosis, which were obtained from nearly 100 individuals, did not differ in fluorine content with any regard to their carious or noncarious history. Many workers have shown that the fluorine content of teeth exhibiting mottled enamel is higher than that of normal sound teeth.

Dr. Krasnow of the Guggenheim Dental Clinic observed that the protein concentration in the saliva from patients with dental caries was definitely higher than in saliva from caries-free patients. Investigators in the Zeller Memorial Dental Clinic at the University of Chicago, employing the germ-free technique, found that a group of 13 white rats living on a normally carious-producing diet for 137 to 150 days experienced no caries in the absence of

microbic life. The control group, fed the same sterilized rations but reared under normal laboratory conditions, had a caries experience of approximately 97 percent. These results appear to support those who maintain that dental caries is associated in some manner with the bacterial flora of the mouth. If that is true, the now demonstrated preventive effect of minimal concentrations of the fluoride ion in drinking water becomes all the more impressive.

Dr. Nicholson

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methods have been subjected to experimentation and some have proved of some worth. Dietary and nutritional habits, proper use of the toothbrush, reduction in intake of refined starches and sugars, good operative procedures, and topical applications of fluorides have all been demonstrated to be good preventive methods. These are in the same category as fluoridation of municipal waters, the only difference being that never before has there been a method devised as cheap, as simple to administer, as effective, and as far reaching as fluoridation.

The practicing dentist can be very proud of his contributions to society in alleviating and eliminating pain, in repairing and restoring impaired or lost dental function, and in helping to develop the operative techniques and procedures associated with an improved treatment service. In the modern conception of health service, however, these contributions are not enough. Each practicing dentist, in addition to being a good operative dentist, must thoroughly ground himself in preventive and control service as well. As a highly specialized individual he must exert all his efforts toward solving the dental health problem.

All practicing dentists must realize the seriousness of the dental health problem facing the public and the profession. Preventive and control methods are the only logical approach to the problem, since we will never be able to keep pace with the present rate of dental caries. The incidence must be reduced appreciably. All proved methods of reducing the incidence of dental caries, especially the fluoridation of municipal waters, must be given serious and continuous consideration.

Even though he may not realize it, the practitioner has a large stake in dental public health. Raising the standards of dental health in his community is certainly one of the obligations of a dentist. When a patient wishes to discuss the fluoridation process, the dentist should use the facts readily available to him rather than evade the issue with faint praise. By so doing he will take the lead in preventing misunderstanding and confusion. He will also be instrumental in bringing to his community one of the best procedures yet discovered for the control of dental caries.

Dr. Bull

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health by reducing caries attack rates 60 percent in children. Most communities have an earnest desire to improve the health of the public, but they are fearful of adopting some program which might eventually prove to be a boomerang.

There has been some complaint that the dental profession has done little to prevent dental caries on a public health basis.

The local dental society is the dental authority in any community, and the local dentists, with assistance from the State dental society and State department of health, must take the initiative in following through on a fluoridation program. They must assume the same leadership, courage, and persistence that was shown when earlier public health measures were inaugurated.

From a public health viewpoint fluoridation has many local features which are necessary for a successful community health program.

1. It can be carried out in its entirety through existing facilities.
2. It requires no special effort or participation on the part of the individuals of a community.
3. The reduction in dental caries (65 percent) is great enough to warrant its adoption by the community.
4. The cost of the program is so small that it can easily be justified in any community.
5. There are no known objectionable features to a program of water fluoridation.
6. It is a program which can be readily understood by the community.
7. Fluoridation has been in actual operation

long enough (6 years) to prove that the mechanics and controls are accurate and simple and that the dental health benefits obtained with controlled fluoridation equal natural fluoridation.

One thing must be guarded against in the fluoridation program. That is the belief that once the communal water supply has been fluoridated the whole dental health problem has been solved. Nothing could be further from the truth. It will take about 14 years after a community starts fluoridating before a two-thirds reduction can be made in the caries attack rate of all children. And even after fluoridation has been carried on for a long period of time, one-third of our present dental decay rate will still be with us.

It is our obligation to see to it that all communities fluoridate their water supplies. It is likewise our obligation to see to it that all communities have an adequate dental health program and utilize all dental health measures which will improve dental health. The *American Journal of Public Health* aptly summarizes the fluoridation program in these words, "What are we waiting for?"

Entomologists Discuss Radioactive Houseflies

The byproducts of atomic energy are now aiding entomologists in tracing the complex chemical and biological processes of insects, and also to enhance their studies of insect behavior, such as the flight range of the common housefly. Scientists of the Communicable Disease Center, Public Health Service, are using radioisotopes to mark flies for identification when later recaptured.

The housefly was described as a hobo with a cruising range of 8 miles or more, the meeting of the American Association of Economic Entomologists in Cincinnati, December 11, 1951, was told. Flight-range studies, important in measuring the insect's role in disease transmission and in planning effective control operations, were reported by Dr. H. F. Schoof, of Atlanta, Ga., R. E. Siverly, of Phoenix, Ariz., and J. A. Jensen, of Savannah, Ga., who made their experiments in Phoenix, and by K. D. Quarterman, W. Mathis, and J. W. Kilpatrick, all of Savannah, who collaborated on tests in Georgia.

For the flight-range tests, the flies are tagged with an extremely tiny amount of radioactivity, less than one finds in a radium watch dial, and so little that it is harmless to man. A counting device is used to isolate the "hot" flies upon recapture. By its use 10 radioactive flies can be isolated from 50,000 flies in less than 5 minutes.

The flight-range studies have shown: More than 80 percent of flies captured were trapped within 1 mile of the release site, thus indicating major movement in a restricted area; flies appear to move at random from any given site, being attracted by food and breeding materials, called "attractants"; and flies naturally find some areas more attractive than others, hence there is a mass movement toward those areas. Fly control programs are stressing the removal of breeding sources through sanitation. This is pointed out by the recapture in a city market of flies released in a substandard residential area where unsanitary privies were prevalent.