CHAPTER XXII

Medication by Means of the Water Supply

In striking contrast to the removal of objectionable materials from water, described in the preceding chapters, is the addition of substances to make up deficiencies detrimental to health. The first such addition attempted was the periodic dosing of water with iodine to combat goiter; the second, the continuous application of fluorine to prevent decay of teeth or dental caries. Iodization was tried in the years 1923–33; fluorination was inaugurated by plant scale studies in 1945.

Although these practices are medication rather than purification, their possible foreshadowing of great events to come in the water treatment field, particularly if fluorination becomes established, warrants at least brief consideration in this book.

Iodization Against Goiter

From remote times certain glandular swellings on the neck have been attributed to the waters of widely scattered regions of the earth. In more recent times the swellings have been called goiter. Ascribed by many writers to snow waters and by others to ill-defined mineral contents of drinking water, it was finally agreed that goiter was due to a deficiency of iodine. Acting on the belief that a small amount of iodine added to the public water supply at considerable intervals would prevent goiter, three water works in the United States and one in England adopted this practice.

The lead was taken by Rochester, N.Y., in April 1923. The practice was continued for ten years (1, 2, 3).

Eight years after iodization was introduced at Rochester, G. W. Goler, Health Officer (3), wrote that it was still in use, giving a "reduction in simple goiter of more than one-half, as shown by annual medical school inspections. The iodide cost us less than one cent per person per year." He added: "I do not believe that many cities would adopt the procedure even if we could show that goiter had been abolished." No reason for this opinion was given. Presumably Dr. Goler was impressed by the fact that iodization had made no headway else-

where and had been continued in Rochester out of respect for his long-continued able service as health officer and his winsome personality. Dr. Goler's successor in office wrote, in September 1933 (4) that in 1932, "because of economy, we used only one-half the amount of iodide previously used—limiting the number of days that additions were made—but this year we had to omit it entirely."

At Sault Ste. Marie, Mich., a plan was adopted in 1923 for dosing the water supply for a period of two weeks twice a year. This was begun in August 1923. In the fall of that year, "the Michigan Medical Association," City Manager Sherman wrote ten years later (5), "persuaded the salt companies of Michigan to put sodium iodide in table salt, not to remove it in the process of manufacture, after which we felt it was unnecessary to treat the water supply."

In England, the Ilkeston and Heanor Water Board, supplying several places in the county of Derbyshire, where "Derbyshire Neck" was prevalent, applied sodium iodide to its water supply during the year beginning October 1924. Continuous dosing at the rate of 3 oz. per mil.gal. (Imp.) [2.5 oz. per mil.gal. (U.S.)] was practiced. A day's supply of the agent was added to 1 gal. (Imp.) of water. This solution was introduced by drop feed from a suitable glass vessel into the main suction pipe of the main pump. The water came from Meerbrook Sough (a collecting tunnel) and two bored wells. Dr. Barwise, Medical Officer of Health for the county of Derbyshire, who advised iodization, died before the completion of the twelve-month test and the studies he was making (6).

The Anaconda Mining Co., reported H. M. Johnson, Superintendent (7), began iodizing the water supply of Anaconda, Mont., in April 1925. It continued to do so until the fall of 1933, then stopped for "economic reasons." Sodium iodide was added to the water for fourteen days in April and October. Dosing was at the rate of 0.644 lb per mil.gal. or 0.0003 gram per gal. The salt was dissolved in the reservoirs and at a penstock where additional water was drawn for pressure purposes. At the penstock, solution feed was used. The local school board supplied the school children with chocolate-coated iodine tablets in the spring and fall of 1926, then discontinued the practice. Figures supplied by the school board showed that about six per cent of the children had simple goiter. After discontinuance of the services of a full-time school nurse, writes Johnson, the company was unable to obtain figures showing whether goiter among

school children was on the decrease, but it continued to use iodine until the fall of 1933 (7, 8).

Valiant efforts to iodize the water supply of Minneapolis were made in the middle 1920's by Arthur F. Mellen, Filtration Engineer. He won the approval of the Hennepin County Medical Society and the Minneapolis Board of Public Welfare. The Committee on Water Supply of the City Council held hearings on the proposal. Although four of its five members favored the plan, it was not reported out of the committee. All members of a later committee journeyed to the Buffalo convention of the American Water Works Association of 1926 and listened to Mellen's comprehensive paper on the problem (9). Notwithstanding all this, the "strong opposition of the Christian Scientists, the American Medical Liberty League and others," wrote Mellen in 1933, "made it impossible to carry the plan through" (10).

Despite its warm-hearted support over a period of ten years, water iodization against goiter was applied to only four water supplies, soon given up at two and finally abandoned by all. Public apathy, opposition by secular and professional groups, the supply of chocolate-covered iodine tablets to school children, and the supply of salt high in iodine by salt manufacturers checked at the very outset and then brought to an end a promising revolution in water treatment.

A damaging setback to the iodization of public water supplies took place in the very year of its adoption at Rochester. A "most thoroughgoing discussion" of the practice took place at the Annual Conference on Water Purification held at Columbus, Ohio, in the fall of 1923. "The consensus of opinion of the health officers and water purification men attending the joint session," wrote Bolt and Wolman in their official review of the whole subject of iodization for the American Water Works Association (11) seemed to be that "iodine taken internally in almost any form in small amounts regularly constitutes a preventive of simple goiter." The best plan of administering iodine, the conclusions said, was to give it "individually through specially prepared chocolate-covered tablets known under the trade name of 'iodo-stanin.'" The Conference concluded that:

> Medical authorities who have made a study of goiter prevention are inclined to recommend that, if whole populations are to be reached, then manufacturers of common table salt should be required to leave in the salt prepared for usual domestic consumption, "normal" amount of iodine. This amount . . . is being investigated.

Application of iodine in any form to public water supplies for goiter prevention purposes is not recommended. It is a wasteful procedure; and from the standpoint of sound public policy the practice of using the public water supply as a medium of medication is undesirable (11).

In a vigorous analysis of the objections to iodization of water supplies made by the Ohio conference, Bolt and Wolman declared that its practicability had been shown by two cities; that it was "no more medication than the addition of chlorine, lime, soda, alum or iron salts to our water supplies and the day has passed since we objected to these." Twelve conclusions in favor of water iodization were submitted (11). Two were:

The iodization of public water supplies in those places where goiter was shown to be prevalent would be a logical measure for the protection of the whole community. As a *preventive* method against an important disease, it is comparable to chlorination . . . to prevent typhoid fever and other intestinal diseases. . . . Iodization . . . is relatively cheap, simple, can be easily applied and controlled. It has not yet [1925] been tried long enough . . . to furnish conclusive evidence of its efficacy under various conditions. . . . The whole matter of the prevention of goiter should be under the supervision of the health authorities of the community with the advice and assistance of the sanitary engineering department and the local medical profession.

Overlooked by most if not all the writers on iodization except Bolt and Wolman (11) are the studies of the iodine content of various natural waters begun by Chatin in 1850 and his advocation, "for goitrous regions, [of] the placing of small quantities of potash (containing iodine) in the rain water," and of "the use of drinking waters known to contain iodine and foods grown in goiter-free areas." Reports made by several commissions appointed by the Paris Academy of Science to examine Chatin's data and proposals "indicate that, while they accepted his chemical work as sound, they could not come to the point of believing that such minute quantities of iodine as he found could produce such profound physiological changes as are found in goiter. . . ."

Early in 1945 about a third of the table salt produced by the Ohio Salt Co., Wadsworth, Ohio, was being iodized by the addition of 0.01 per cent of finely powdered potassium iodide. It is assumed that the same percentage is applicable to the output of other salt producers and the practice has been increasing. Iodized salt is being added to animal feed supplied to some sections of the United States.

The Michigan State Medical Society appointed an Iodized Salt Committee in 1922. The committee advised iodization. The Mulkey Salt Co. was the first manufacturer to adopt the recommendation and other companies followed suit. In Michigan, a survey showed that in some areas the incidence of endemic goiter among school children of adolescent age dropped from 39 to 4 per cent. The work of the Michigan State Medical Society has been carried on by the American Public Health Association through a Study Committee on Endemic Goiter. On its advice the percentage of potassium iodide added to table salt was reduced to the 0.01 per cent already mentioned. This has been approved by the National Research Council and the Surgeon General of the United States Army. In 1945, the U.S. Army ordered only iodized salt for cooking and table use (12).

Fluorination to Combat Decay of Teeth

Unlike goiter, tooth decay or dental caries is a universal curse. Concern over its ravages and growing hopes of its control by medicating public water supplies led to the inclusion of four papers on the subject in the program of the 1943 Convention of the American Water Works Association (13, 14, 15, 16). Leader of this section of the program was Dr. H. Trendley Dean. His comprehensive review was supplemented by 86 references to the literature of the subject ranging in date from 1874 to 1943. Brief digests of many of these papers, with critical comments, were given by Dr. Dean (13). In opening his discussion, Dr. Dean said:

> Control of dental caries is the fundamental problem of modern dentists. . . . Among civilized people, few individuals escape its attacks. . . . Of the first 2,000,000 [draftees] examined for the Army, the chief cause for rejection was dental defects. During 1941, about $500,000,000 was spent for dental services in the United States . . . despite which these services were supplied to a portion of the population only, the majority receiving either no dental service or merely extraction.

Alarm over mottled teeth enamel in some parts of the United States led to studies in 1916 which later showed that the water supplies of those sections were high in fluorine. They also showed that teeth with mottled enamel were not affected by caries. After reviewing a number of studies of caries incidence in cities using water high and low in fluorides, Dr. Dean said (13):

Theoretically, the idea of fluorination of the domestic water supply for the reduction of dental caries prevalence appears sound. Because of its unusually high prevalence, dental caries seems particularly suited for control measures through a communal medium such as the water supply. It would not involve adding anything not already in water supplies used daily by more than a million people in this country. Furthermore, the amount [of fluorine] suggested, namely, 1 ppm., is considerably lower than many hundreds of thousands of these people are now using daily. Much investigative work, however, is necessary before serious thought can be given to a recommendation for its general application.

As a practical test of the efficiency and safety of fluorination, Dr. Dean (13) suggested that two cities of 40,000 to 50,000 population, using fluoride-free water from the same source, be chosen for study. To the water supply of one of these cities, the "fluoride concentration" would be brought to 1 ppm. A carefully controlled study of the population of each city, born after fluorination in one of them was begun, and continued for "a sufficient number of years, would be necessary to demonstrate that the addition of [1 ppm.] of fluoride to a fluorine-free water will actually reduce the amount of dental caries in the community."

If such an experiment were successful, as much presumptive evidence indicates, public water supplies would fall into three groups:

(1) Those carrying naturally the *optimal* concentration of F, i.e., about 1.0 ppm., and would therefore require no treatment;

(2) Those carrying an *excessive* concentration of F requiring the removal of the excess in order to protect the community against endemic dental fluorosis (mottled enamel); or

(3) Those *deficient* in fluoride, to which fluoride might be added to bring its concentration up to the optimal in order to inhibit dental caries attack.

Viewing the domestic water problem in this light, one might with justification expect that the community's public water supply is destined to play an important role in communal public health (13).

Following Dr. Dean's introduction of the subject, Dr. D. B. Ast of the New York State Department of Health outlined "A Program of Treatment of Public Water Supply to Correct Fluoride Deficiency" (15), which he had developed in his work on oral hygiene.

In the third paper presented on this subject at the 1943 Convention of the American Water Works Association, Harold J. Knapp, Health Commissioner of Cleveland (14), urged that "in any public health program, it is necessary that the several scientific professions concerned . . . each play its role in a cooperative endeavor." He added:

It is fitting that a testimonial be expressed to the imagination, the vision and the courage of the engineering profession. Through the years it has blazoned many a trail in public health. Certainly without its ingenuity and its continuing research, we should not now enjoy the benefits of the modern methods and appliances which protect us from disease. Would it not be tragic to be compelled to lapse back to the primitive conditions of yesteryear?

It is our official duty as health officers (and certainly it is our personal desire) to be alert to the research and to the progress in applied engineering practice; to the end that we shall neither be the first to reject nor the last to accept.

Abel Wolman (16) summed up the case for fluorination and echoed with emphasis the warning that there is urgent need for further study before recommending its general adoption. He agreed with Dr. Dean's conclusions that "a small amount of fluorine contributes to a high level of dental health" and that "there are sound reasons and sound hopes" for attempting "to solve an almost insoluble" problem "by the mass handling of dental caries, which so far has not succumbed successfully to individual patient treatment." Continuing, Wolman recalled the "severe medical, engineering and legal controversy," accompanied by acrimonious debate, over the addition of alum to water as a coagulant; and later over the addition of chlorine as a disinfectant. In both cases, he said:

We had an amazing set of controversies which ran through the courts, through most of the medical associations, and all of the engineering associations, in order to prove . . . that the balance of values was in favor of, and not against, the public. . . . That whole history, however, covered the efforts to eliminate products from water rather than [as now] to introduce new complexes of a chemical or biological nature.

In closing, Wolman again reiterated Dr. Dean's warning that much investigation would be necessary before fluorination of water supplies could be recommended for general adoption (16).

Prior to his participation in the forum, Dr. Ast had prepared a comprehensive thesis on the caries-fluorine hypothesis "to present the story of dental caries as it exists today, to present its public health significance and to suggest a study for its control," in which he "proposed to introduce nontoxic doses of sodium fluoride into public drinking waters to test the fluorine hypothesis, which points to an inverse ratio of caries to fluorides present in drinking water" (17).

In general accordance with Dr. Ast's plan, the New York State Department of Health made arrangements to apply sodium fluoride to

the water supply of Newburgh, N.Y., beginning in or about May 1945. As outlined by C .R. Cox, Chief of the Bureau of Water Supply of the State Department (18), a small dry-feed dosing apparatus will be used to apply commercial sodium chloride to the filtrate of four filters on its way to the filtered water reservoir. The water supply of Newburgh has a natural fluorine content of from less than 0.05 to 0.17 ppm., varying with seasonal influences.

For control purposes, the city of Kingston, N.Y., will be used. Its population is about the same as that of Newburgh. The Kingston supply "contains no detectable fluorine" (18).

The result of the studies of teeth-decay control by adding fluorine to public water supplies will be awaited with interest. Indications are that many years will be required to determine its theoretical efficiency, its physical and financial practicability, and the willingness of city authorities and private water companies to accept the wholesale medication of public water supplies.

What the future holds in store for the water works man in the field of mass medication remains to be seen. But the fact that the public water supply can now be seriously considered as an appropriate and safe vehicle for the distribution of the physician's prescription is fitting tribute to the success of man's quest for pure water.

CHAPTER XXII

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