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| Our Nov 2010 cover | **Fluoridation: Medicating our Water Part 1***by Gary Null, PhD* |

From the Townsend Letter

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Fluoridation: Medicating our Water

Part 1

by Gary Null, PhD Part 2 and Part 3 are also online

There's nothing like a glass of cool, clear water to quench one's thirst. But the next time you or your child reaches for one, you might want to question whether that water is too toxic to drink. If your water is fluoridated, the answer may well be yes.

For decades, we have been told a lie, a lie that has led to the deaths of hundreds of thousands of Americans and the weakening of the immune systems of tens of millions more. This lie is called fluoridation. A process that we were led to believe was a safe and effective method of protecting teeth from decay is in fact a fraud.

In recent years it has been shown that fluoridation is neither essential for good health nor protective of teeth. What it does do is poison the body. Thus, some fundamental questions arise: (1) How is it possible that the public has all been misled? (2) why does public health policy and the American media continue to live with and perpetuate this scientific sham?

The History of Fluoride, a Toxic Waste

"We would not purposely add arsenic to the water supply. And we would not purposely add lead. But we do add fluoride. The fact is that fluoride is more toxic than lead and just slightly less toxic than arsenic."1

These words of Dr. John Yiamouyiannis may come as a shock to you because, if you're like most Americans, you have positive associations with fluoride. You may envision tooth protection, strong bones, and a government that cares about your dental needs. What you may not know is that the fluoride added to drinking water and toothpaste is a crude industrial waste product of the aluminum and fertilizer industries, and a substance toxic enough to be used as rat poison. How is it that Americans have learned to love an environmental hazard? This phenomenon can be attributed to a carefully planned marketing program launched even before Grand Rapids, Michigan, became the first community to officially fluoridate its drinking water in 1945.2 As a result of this ongoing campaign, nearly two-thirds of the nation has enthusiastically followed Grand Rapids's example. But this push for fluoridation has less to do with a concern for America's health than with industry's penchant to expand at the expense of our nation's well-being.

What is Fluoride?

Many people associate fluoride with its periodic table namesake, fluorine. While fluorine is an element (a gas that is frequently listed as a trace mineral and human nutrient), fluoride is very different. Fluoride is a compound of fluorine, and while fluorine is one of earth's natural elements, fluoride is a chemical byproduct ("chemical byproduct" = toxic waste) of aluminum, phosphate, cement, steel, and nuclear weapons manufacturing.3 Its toxicity was recognized at the beginning of the Industrial Revolution, when in the 1850s iron and copper factories discharged it into the air and poisoned plants, animals, and people.

In the early years of the 20th century, a young dentist named Frederick McKay settled in Colorado Springs, Colorado. There he discovered that as many as 90% of lifetime residents of the town had grotesque brown stains on their teeth, and that the tooth enamel had an irregular surface texture described as "mottled." Locals referred to the familiar condition as Colorado Brown Stain, but no one had a clue as to its cause. Over the next two decades Dr. McKay, later with the help of dental researcher G. V. Black, proved that the cause was something contaminating the water supply. They also speculated that the affected teeth might be somewhat more resistant to decay.4

By the 1920s, rapid industrial growth had exacerbated the problems of industrial pollution, and fluoride was one of the biggest problems. Medical writer Joel Griffiths explains that "it was abundantly clear to both industry and government that spectacular U.S. industrial expansion – and the economic and military power and vast profits it promised – would necessitate releasing millions of tons of waste fluoride into the environment." Their biggest fear was that "if serious injury to people were established, lawsuits alone could prove devastating to companies, while public outcry could force industry-wide government regulations, billions in pollution-control costs, and even mandatory changes in high-fluoride raw materials and profitable technologies."5

In 1931, by means of photospectrographic analysis of McKay and Black's water samples conducted at the laboratories at the Aluminum Company of America (Alcoa), it was confirmed that the cause of the mottled teeth was fluoride in the water supply. Alcoa took a proprietary interest in this issue, since fluoride is a major waste product of aluminum production. The company wanted to know how much fluoride exposure people could tolerate without getting mottled, discolored teeth. Or, more specifically, how much fluoride could Alcoa release into the nation's earth, water, and air without the public realizing that the company was polluting the environment with a powerful toxin?

That question was to be addressed later that same year, when H. Trendley Dean was sent to study water sources in 345 Texas communities. Dean, a former dental surgeon for the US Public Health Service, was then head of the Dental Hygiene Unit of the National Institute of Health. (Dean's overseer and mentor at the USPHS had been Treasury Secretary Andrew W. Mellon, a founder and major stockholder of Alcoa.) Based on his own research, Dean claimed that "fluoride levels of up to 1.0 ppm in drinking water did not cause mottled enamel; if the fluoride exceeded this level, however, fluorosis would occur."6

Dean, while establishing the threshold for fluoridation, also explored the idea that fluorosis victims' mottled, discolored teeth were especially decay resistant. Dean suspected that 1 ppm of fluoride added to the water supply would prevent tooth decay, while avoiding damage to bones and teeth.7 He recommended further studies to determine whether his hypothesis was true.

According to Griffiths, the news that adding fluoride to the water supply for improved dental health was "galvanic," particularly to the Mellon Institute (Alcoa's Pittsburgh industrial research lab). Consequently, they initiated their own research. Biochemist Gerald J. Cox immediately fluoridated some lab rats in a study and concluded that fluoride reduced cavities and that: "The case should be regarded as proved." In a historic moment in 1939, the first public proposal that the US should fluoridate its water supplies was made not by a doctor, or dentist, but by Cox, an industry scientist working for a company threatened by fluoride damage claims and burdened by the odious expense of disposing of tons of toxic industrial waste. Cox began touring the country, campaigning for fluoridation.8

Dean, meanwhile, continued his research and became the authority on public water fluoridation. He became the first dental scientist at the National Institute of Health, advancing to director of the dental research section in 1945. After World War II, he directed epidemiological studies for the Army in Germany. When Congress established the National Institute of Dental Research (NIDR) in 1948, Dean was appointed its director, a position he held until retiring in 1953.9 In his post at the NIDR, he oversaw the first clinical trial of fluoridation in an American city: Grand Rapids, Michigan.10

With Dean's impressive credentials, it is easy to assume – and many do – that his findings were scientifically sound. Unfortunately, Dean's "science," when placed under further scrutiny, is shaky, not solid; biased, not impartial; and, above all, hardly a standard sound enough to launch mass fluoridation. An independent study of his results revealed that he had engaged in "selective use of data," employing figures from 21 cities that confirmed his findings, and ignoring those from 272 other localities that didn't.11 In a 1955 court case challenging fluoridation, Dean admitted under oath that his published conclusions were wrong.12 In hearings conducted by the AMA in 1957, he was forced to admit that dental fluorosis, the first sign of fluoride overdose, could be caused by water fluoridated at 1.0 ppm.13 Shockingly, these admissions were not widely publicized, and they were never acknowledged by the USPHS, the American Dental Association (ADA), or the other governmental bodies responsible for foisting fluoride on the public. Consequently, this dangerous industrial-waste carcinogen is still dumped in our water today.

At first, industry could dispose of fluoride legally only in small amounts by selling it to insecticide and rat-poison manufacturers.14 But Dean's "discovery" paved the way for a commercial outlet for the toxin. Griffiths writes that this was not a scientific breakthrough, but rather part of a "public disinformation campaign" by the aluminum industry "to convince the public that fluoride was safe and good." Industry's need prompted Alcoa-funded scientist Gerald J. Cox to announce: "The present trend toward complete removal of fluoride from water may need some reversal."15 Griffiths writes:

The big news in Cox's announcement was that this 'apparently worthless by-product' had not only been proved safe (in low doses), but actually beneficial; it might reduce cavities in children. A proposal was in the air to add fluoride to the entire nation's drinking water. While the dose to each individual would be low, 'fluoridation' on a national scale would require the annual addition of hundreds of thousands of tons of fluoride to the country's drinking water.

Government and industry – especially Alcoa – strongly supported intentional water fluoridation. ... [It] made possible a master public relations stroke – one that could keep scientists and the public off fluoride's case for years to come. If the leaders of dentistry, medicine, and public health could be persuaded to endorse fluoride in the public's drinking water, proclaiming to the nation that there was a 'wide margin of safety,' how were they going to turn around later and say industry's fluoride pollution was dangerous?

As for the public, if fluoride could be introduced as a health enhancing substance that should be added to the environment for the children's sake, those opposing it would look like quacks and lunatics. ...

Back at the Mellon Institute, Alcoa's Pittsburgh Industrial research lab, this news was galvanic. Alcoa-sponsored biochemist Gerald J. Cox immediately fluoridated some lab rats in a study and concluded that fluoride reduced cavities and that 'The case should be regarded as proved.' In a historic moment in 1939, the first public proposal that the US should fluoridate its water supplies was made – not by a doctor, or dentist, but by Cox, an industry scientist working for a company threatened by fluoride damage claims.16

Once the plan was put into action, industry was buoyant. It had finally found the channel for fluoride that it was looking for, and it was even cheered on by dentists, government agencies, and the public. Chemical Week, a publication for the chemical industry, described the tenor of the times when it exclaimed: "All over the country, slide rules are getting warm as waterworks engineers figure the cost of adding fluoride to their water supplies." The article further explained that the general public quickly adhered to the new trend urged upon them by the USPHS, the ADA, the state dental health directors, various state and local health bodies, and vocal women's clubs from coast to coast. It further said: "[fluoridation] adds up to a nice piece of business on all sides and many firms are cheering the PHS and similar groups as they plump for increasing adoption of fluoridation."17

Such overwhelming acceptance allowed government and industry to proceed hastily, albeit irresponsibly. The Grand Rapids experiment was supposed to take 15 years, during which time health benefits and hazards were to be studied. In 1946, however, just one year into the experiment, six more US cities adopted the process. By 1947, 87 more communities were treated; popular demand was the official reason for this unscientific haste.

The general public and its leaders did support the cause, but only after a massive government public relations campaign spearheaded by Edward L. Bernays, (a nephew of Sigmund Freud). Bernays, a public relations pioneer who has been called "the original spin doctor,"18 was a masterful PR strategist. As a result of his influence, Griffiths writes, "Almost overnight ... the popular image of fluoride – which at the time was being widely sold as rat and bug poison – became that of a beneficial provider of gleaming smiles, absolutely safe, and good for children, bestowed by a benevolent paternal government. Its opponents were permanently engraved on the public mind as crackpots. ..."19

Griffiths explains that while opposition to fluoridation is usually associated with right-wingers, this picture is not totally accurate. He provides an interesting historical perspective on the antifluoridation stance:

Fluoridation attracted opponents from every point on the continuum of politics and sanity. The prospect of the government mass-medicating the water supplies with a well-known rat poison to prevent a nonlethal disease flipped the switches of delusionals across the country – as well as generating concern among responsible scientists, doctors, and citizens.

Moreover, by a fortuitous twist of circumstances, fluoride's natural opponents on the left were alienated from the rest of the opposition. Oscar Ewing, a Federal Security Agency administrator, was a Truman fair dealer who pushed many progressive programs such as nationalized medicine. Fluoridation was lumped with his proposals. Inevitably, it was attacked by conservatives as a manifestation of creeping socialism, while the left rallied to its support. Later during the McCarthy era, the left was further alienated from the opposition when extreme right-wing groups, including the John Birch Society

and the Ku Klux Klan, raved that fluoridation was a plot by the Soviet Union and/or communists in the government to poison America's brain cells.

It was a simple task for promoters, under the guidance of the 'original spin doctor,' to paint all opponents as deranged – and they played this angle to the hilt. ...

Actually, many of the strongest opponents originally started out as proponents, but changed their minds after a close look at the evidence. And many opponents came to view fluoridation not as a communist plot, but simply as a capitalist-style con job of epic proportions. Some could be termed early environmentalists, such as the physicians George L. Waldbott and Frederick B. Exner, who first documented government-industry complicity in hiding the hazards of fluoride pollution from the public. Waldbott and Exner risked their careers in a clash with fluoride defenders, only to see their cause buried in toothpaste ads.20

By 1950, fluoridation's image was a sterling one, and there was not much science could do at this point. The USPHS was fluoridation's main source of funding as well as its promoter, and therefore caught in a fundamental conflict of interest.21 If fluoridation were found to be unsafe and ineffective, and laws repealed, the organization feared a loss of face, since scientists, politicians, dental groups, and physicians unanimously supported it.22 For this reason, studies concerning its effects were not undertaken. The Oakland Tribune noted this when it stated: "Public health officials have often suppressed scientific doubts" about fluoridation.23 Waldbott sums up the situation when he states that, from the beginning, the controversy over fluoridating water supplies was "a political, not a scientific health issue."24

The clever marketing of fluoride continued. In a 1983 letter from the Environmental Protection Agency, Rebecca Hammer, then deputy assistant administrator for water, wrote that EPA's stance on fluoridation: "[the EPA] regards [fluoridation] as an ideal environmental solution to a long-standing problem. By recovering by-product fluosilicic acid from fertilizer manufacturing, water and air pollution are minimized and water utilities have a low-cost source of fluoride available to them."25 More recently, a 1992 policy statement from the Department of Health and Human Services (DHHS) says: "A recent comprehensive PHS review of the benefits and potential health risks of fluoride has concluded that the practice of fluoridating community water supplies is safe and effective."26

Today, nearly 250 million people worldwide drink fluoridated water, including about 130 million Americans in 9,600 communities. Out of the 50 largest cities in the US, 41 have fluoridated water.27

To help celebrate fluoride's widespread use, the media recently reported on the 50th anniversary of fluoridation in Grand Rapids. Newspaper articles titled "Fluoridation: a Shining Public Health Success"28 and "After 50 Years, Fluoride Still Works with a Smile"29 painted glowing pictures of the practice. Had investigators looked more closely, though, they might have learned that children in Muskegon, Michigan, a nearby unfluoridated "control" city, had equal drops in dental decay. Had they looked closer, they would have seen the dangerous truth behind the supposed wonder of fluoride.

The Fluoride Myth Doesn't Hold Water

The big hope for fluoride was its ability to immunize children's developing teeth against cavities. Rates of dental caries were supposed to plummet in areas where water was treated. Yet decades of experience and worldwide research have contradicted this expectation numerous times. Here are just a few examples:

In British Columbia, only 11% of the population drinks fluoridated water, as opposed to 40%–70% in other Canadian regions. Yet British Columbia has the lowest rate of tooth decay in Canada. In addition, the lowest rates of dental caries within the province are found in areas that do not have their water supplies fluoridated.30

According to a Sierra Club study, people in unfluoridated developing nations have fewer dental caries than those living in industrialized nations. As a result, researchers concluded that "fluoride is not essential to dental health."31

In 1986–1987, the largest study on fluoridation and tooth decay ever was performed. The subjects were 39,000 schoolchildren ages 5 to 17 living in 84 areas around the country. A third of the places were fluoridated, a third were partially fluoridated, and a third were not. Results indicate no statistically significant differences in dental decay between fluoridated and unfluoridated cities.32 The benefit to fluoridated communities, if there is any, amounts to 0.6 fewer decayed tooth surfaces per child, which is less than 1% of the tooth surfaces in a child's mouth.33

A World Health Organization survey reports a decline of dental decay in western Europe, which is 98% unfluoridated. It states that western Europe's declining dental decay rates are equal to and sometimes better than those in the US.34

A 1992 University of Arizona study yielded surprising results when it found that "the more fluoride a child drinks, the more cavities appear in the teeth."35

Although all Native American reservations are fluoridated, children living there have much higher incidences of dental decay and other oral health problems than do children living in other US communities.36

A 1999 study of water fluoridation in Italy shows that socioeconomic status, area of residence, and sugar consumption are more significant predictors of dental caries than fluoride consumption. The authors conclude that universal fluoridation is an inadequate approach and the decision to fluoridate or defluoridate water requires careful epidemiological consideration.37

A 2001 article in the Journal of the American Dental Association admits that the fluoride that is swallowed and incorporated into teeth is "insufficient to have a measurable effect" on reducing cavities.38 This is a stunning admission from the ADA, historically one of the principal supporters and defenders of water fluoridation.

A follow-up of a study of the town of Kuopio, Finland, six years after fluoridation was discontinued found no increase in dental caries. The authors conclude that fluoridation was unnecessary to begin with.39

A study comparing prevalence and incidence of caries in 2,994 lifelong residents of British Columbia, Canada, in grades 5, 6, 11, and 12 found that caries incidence was not different between the still-fluoridating and fluoridation-ended communities.40

In 1997, following the cessation of drinking water fluoridation in La Salud, Cuba, caries prevalence remained at a low level for the 6- to 9-year-olds and appeared to decrease for the 10- and 11-year-olds. In the 12- and 13-year-olds, there was a significant decrease, while the percentage of caries-free children of this age group had increased from 4.8 (1973) and 33.3 (1982) up to 55.2%.41

A 1998 study conducted in New Zealand found that "when the timing of various forms of fluoride supplementation is correlated with the decline in caries, the decline continues beyond the time of maximum population coverage with fluoridated water and fluoridated toothpaste." The authors call for a "reassessment of the fluoride effect."42

In contrast to the anticipated increase in dental caries following the cessation of water fluoridation in the German cities Chemnitz (formerly Karl-Marx-Stadt) and Plauen, a significant fall in caries prevalence was observed. This trend corresponded to the national caries decline and appeared to be a new populationwide phenomenon.43

A 1999 New York State Department of Health study of 3,500 7- to 14-year-olds shows that children in fluoridated Newburgh, New York, have no less tooth decay but significantly more dental fluorosis than children from Kingston, New York, which has never been fluoridated. Since 1945, children of the two towns have been examined periodically to demonstrate that fluoridation reduces tooth decay. "This new research shows the experiment has failed," the report concludes.44 A similar comparison revealed: "In most European countries, where [water fluoridation] has never been adopted, a substantial decline [75%] in caries prevalence has been reported in the last decades."45

In light of all the evidence, fluoride proponents now make more modest claims. For example, in 1988, the ADA professed that a 40% to 60% cavity reduction could be achieved with the help of fluoride. Now they claim an 18% to 25% reduction. Other promoters mention a 12% decline in tooth decay.

And other former supporters are even beginning to question the need for fluoridation altogether. In 1990, a National Institute for Dental Research report stated: "It is likely that if caries in children remain at low levels or decline further, the necessity of continuing the current variety and extent of fluoride-based prevention programs will be questioned."46 This is a startling claim coming from the very same governmental organization that spearheaded the drive for compulsory water fluoridation.

A 1999 review of literature conducted by Dr. Hardy Limeback, a long-time advocate of water fluoridation in Canada, indicates that the topical effect of fluoride is its primary mechanism for the prevention of dental caries. Swallowing fluoridated water is ineffective and unnecessary. Limeback concludes that everyone working in the dental health field must examine more closely the risks and benefits of fluoride in all its delivery forms.47 According to Limeback, head of preventive dentistry at the University of Toronto, "Dental decay rates in North America are so low that water fluoridation provides little to no benefit whatsoever these days. In fact, studies show that when you turn the water fluoridation taps off and look for dental decay rates, they don't move whatsoever. There is no increase in dental decay when you stop fluoridating."48 Limeback adds that what you do see is an increase in unsightly dental fluorosis.49 Today fluorosis occurs on two or more teeth in 30% of children in areas where the water is fluoridated, and not always in its mildest form.50

In a letter published in 1999, dentist and public health official Dr. John Colquhoun, formerly one of New Zealand's most prominent profluoridation advocates and educators, explains how over the course of years he came to recognize that there was no benefit in water fluoridation, and that children's dental health is slightly better in nonfluoridated areas than in fluoridated ones.51 As another sign of the growing disillusionment with fluoridation, the National Institutes of Health conducted an intensive review of the data supporting fluoride in tap waters, looking at over 560 studies, and expressed in a 2001 news release its disappointment in "the overall quality of the clinical data that it reviewed. According to the panel, far too many studies were small, poorly described, or otherwise methodologically flawed."52

Most government agencies, however, continue to ignore the scientific evidence and to market fluoridation by making fictional claims about its benefits and pushing for its expansion. For instance, according to the DHHS, "National surveys of oral health dating back several decades document continuing decreases in tooth decay in children, adults and senior citizens. Nevertheless, there are parts of the country and particular populations that remain without protection. For these reasons, the USPHS ... has set a national goal for the year 2000 that 75% of persons served by community water systems will have access to optimally fluoridated drinking water; currently this figure is just about 60%. The year 2000 target goal is both desirable and yet challenging, based on past progress and continuing evidence of effectiveness and safety of this public health measure."53

This statement is flawed on several accounts. First, as we've seen, research does not support the effectiveness of fluoridation for preventing tooth disease. Second, purported benefits are supposedly for children, not adults and senior citizens. At about age 13, any advantage fluoridation might offer comes to an end, and less than 1% of the fluoridated water supply reaches this population.54 And third, fluoridation has never been proven safe. On the contrary, numerous studies directly link fluoridation to disease, including skeletal fluorosis, dental fluorosis, thyroid disorders, brain and kidney damage, Alzheimer's disease, lead poisoning, and several rare forms of cancer. This alone should force us to reconsider its use.

Biological Safety Concerns

Only a small margin separates supposedly beneficial fluoride levels from amounts that are known to cause adverse effects. Dr. James Patrick, a former antibiotics research scientist at the National Institutes of Health, describes the predicament:

[There is] a very low margin of safety involved in fluoridating water. A concentration of about 1 ppm is recommended. ... in several countries, severe fluorosis has been documented from water supplies containing only 2 or 3 ppm. In the development of drugs... we generally insist on a therapeutic index (margin of safety) of the order of 100; a therapeutic index of 2 or 3 is totally unacceptable, yet that is what has been proposed for public water supplies.55

Other countries argue that even 1 ppm is not a safe concentration. Canadian studies, for example, imply that children under 3 should have no fluoride whatsoever. The Journal of the Canadian Dental Association states that "fluoride supplements should not be recommended for children less than 3 years old."56 Since these supplements contain the same amount of fluoride as water does, they are basically saying that children under the age of 3 shouldn't be drinking fluoridated water at all, under any circumstance. Japan has reduced the amount of fluoride in its drinking water to less than one sixth of what is recommended in the US: instead of 1 milligram per liter, the upper limit allowed is 0.15 milligram per liter.57

The 1 ppm dosage recommendation for water fluoridation has a checkered past, and its present is even more so. As we have seen, the first mention of this "magic" number was made by Dean, who jiggled his results to reach the conclusion that "fluoride levels of up to 1.0 ppm in drinking water did not cause mottled enamel; if the fluoride exceeded this level, however, fluorosis would occur."58

But the adoption of this dosage for water fluoridation was not Dean's brainchild. It was set in 1953 by Harold C. Hodge, PhD, then chairman of the US National Academy of Sciences (NAS) committee on toxicology. Unfortunately, Hodge made a serious miscalculation in his estimate of the safe dosage level for fluoride. His figures err by a factor of 2.25, which means that they understate the toxicity of fluoride considerably. The story of this potentially fatal miscalculation is told in a document from the UK National Pure Water Association:

It is important when any new drug is marketed that the dose at which it is toxic is determined. There is then a margin allowed for safety (usually a factor of 100) and a maximum dose is published. In 1953 the National Academy of Sciences published their estimate of the quantity of fluoride which produces the condition known as crippling skeletal fluorosis. The calculation was done by a famous toxicologist, Harold C. Hodge, Ph.D., who was chairman of the US National Academy of Sciences (NAS) committee on toxicology.

To arrive at his figures, Hodge cited a classic study of the effects of fluoride among cryolite workers by a European researcher, Kaj Roholm, and published in 1937. Roholm's dosage figures were presented in milligrams of fluoride per kilogram of body weight. In his study, Roholm showed that at levels of 0.2 to 0.35mg/kg some workers developed crippling skeletal fluorosis in a very short time. The first stage of the disease appeared, in general, after 2 1/2 years; Stage two was reached by 4 1/2 years; and crippling skeletal fluorosis appeared after 11 years.59

Hodge wanted to apply Roholm's figures to a typical range of body weights in order to set a maximum intake level in milligrams per day. But Hodge was American and used to dealing in pounds rather than kilograms. By using a range of body weights from 100 to 229 pounds, he multiplied the 0.2 mg figure by 100 pounds, giving a figure of 20 mg/day; and 0.35 mg by 229 pounds yielded 80 mg/day. Thus the amounts of fluoride that would cause crippling skeletal fluorosis, he said, were 20 mg to 80 mg per day. And rather than quote Roholm's 11-year figure for crippling fluorosis, he gave a range of 10 to 20 years. These are the figures that appear in the ADA pamphlet "Fluoridation Facts," and on which many other articles are based, even today.

But Hodge made a simple but significant error. Roholm's figures were not for pounds. They were milligram per kilogram figures. Unfortunately, Hodge was the expert; and no one, apparently, checked his figures. This error, which gave a false safety margin more than double what it should have been went unnoticed for many years until antifluoride campaigner Darlene Sherrell tried to duplicate Hodge's arithmetic and couldn't make it add up. She worked out that Hodge had made an error when he neglected to convert pounds to kilograms.

Correcting for this error, Sherrell reduced the amount of fluoride needed to be crippling to 10 to 25 milligrams per day, for 10 to 20 years.

But fluorides accumulate throughout our lives so a higher intake will have the same effect in a shorter time, and smaller doses will have the same effect in a longer time. If we apply Roholm's dosage figures to a lifetime of 55 to 96 years, just 1 mg per day (the amount in one liter of water) for each 55 pounds of body weight could be a crippling dosage.

The Academy Admits that It Was Wrong

In 1989 Sherrell wrote to the NAS and asked on what they based their 20 to 80 mg/day figures. Two years passed before the academy told her that it had identified Hodge's interpretation of Roholm as the data source.

Four years later the error was finally corrected by the National Research Council's Board on Environmental Studies and Toxicology in its 1993 publication "Health Effects of Ingested Fluoride,"where it changed the figure from 20–80mg/day to 10–20mg/day.60

As it happens, Hodge had written a chapter in a book released in 1979 titled Continuing Evaluation of the Use of Fluorides. In it Hodge had corrected his previously published figures. But nobody seemed to notice. In 1991, when the DHHS published its "Review of Fluoride: Benefits and Risks," it continued to use figures of 20–80 mg/day as the "crippling daily dose of fluoride." As indeed does the current Dietary Reference Intake, published by the Institute of Medicine in 1997.

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