

# Fluoride: risks and benefits?

## *Disinformation in the service of big industry*

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### SUMMARY

Promoters of water fluoridation offer the lure of strong, healthy teeth and reduced dental bills as inducements for communities to fluoridate their water. Fluoride is also promoted for other tooth-related uses. However, even the promoters have scaled down the benefits claimed for water fluoridation and admitted the danger of fluorosis from toothpaste. For every study by promoters over recent years repeating old messages that claim undisputed water fluoridation benefits—particularly reduction of cavities, there are equally reputable studies showing little or no effect on cavity rates. Studies in mainstream peer-reviewed medical journals and government reports now document the fact that serious harms are associated with exposure to small amounts of fluoride—including hip fracture, cancer, and intellectual impairment.

There is evidence that both individual and institutional fluoride promoters have stacked the deck, manipulated experimental results, suppressed evidence that spoke against their view, and victimised or smeared those who spoke out against them.

When old ways and knowledge are increasingly found to be based on false premises, incompetence, bias and worse, it is important to re-examine the old claims, and to take account of the growing body of research that show they are at best equivocal and at worst completely opposite to the truth, and based on vested interest.

Fluoride promotion often proceeds with no understanding of the scientific method and sometimes without even the ability to perform simple arithmetic. The most important US Congress-mandated study in recent times on the suspected connection between fluoride and cancer was subjected to a series of Public Health Service review stages that successively downgraded the results from the original independent laboratory study to the point where they were declared “equivocal” and largely ignored. The proven association of fluoride and water fluoridation with increased hip fractures and reduced bone quality has been denied or downplayed. Many other lines of investigation have been ignored or not followed up in an open-minded manner.

Medical ethics, morality, economics, legal and political issues have not deterred fluoride promoters in their efforts. Indeed, the problem has been declared a legislative matter, rather than under the jurisdiction of courts of law which might introduce such notions as ethics and reasonableness. The main beneficiaries from fluoride use are the big industries that find a profitable outlet for their otherwise embarrassing toxic byproducts. It is time for change.

*A majority vote which violates ethical or moral principles, or deprives individuals of rights they should be free to enjoy, is not democracy but tyranny. It is a subversion of democracy that will bring democracy to an end in the degree that it is allowed to operate.*

*(the late F.B. Exner, MD FACR, Seattle)*



## 1. Introduction

We should all like to have strong, healthy teeth, the “benefit” promoters of water fluoridation offer. Water fluoridation, they say, has been proven in literally tens of thousands of studies to be completely safe, to provide a reduction in tooth decay of anything up to 70%, and has never caused an adverse reaction at the “optimal concentration” of one part per million (1 ppm)—no allergies, no cancer risks, nothing. It is not just good for children’s teeth, but for everyone’s teeth—especially old people’s, and it may even strengthen bones. Why would any sane person oppose water fluoridation?

The answer is complex, but can be characterised by five statements of fact documented, where appropriate, in the peer reviewed medical literature:

- If it works at all, the benefits are very much less than claimed
- It is strongly linked to three-fold increases in hip and other non-vertebral fracture rates; there is growing evidence of other even more serious medical consequences
- A recent study showed evidence of intellectual impairment caused by fluoride
- There is clear evidence that promoters have stacked the deck, suppressed evidence, and victimised or smeared those who speak out against the practice
- Given a recommendation for medication, individuals in a free society have a right to choose whether or not to accept treatment, a right to expect properly controlled dosage and medical supervision, and a right to be told the truth. Water fluoridation abrogates these rights

Much more information is available than is reasonable to present in this paper. However, the reader should gain some insight into the problems occurring in the debate on water fluoridation, and be able to decide for themselves whether the controversy is false or not. My own conclusion is that there are, at best, real unresolved and serious questions about the safety and benefit of water fluoridation and related uses of fluoride. The most recent evidence suggests it is not particularly beneficial, and certainly not safe. The most charitable interpretation that one can put on the situation is that old habits die hard, and the medical/dental establishment is slow to adapt to the realities of modern research, and fearful of losing both face and law suits if they admit they made a mistake.

## 2. The scientific method

The controversy surrounding the risks and benefits of water fluoridation switched from science to politics almost as soon as it started in the 40s and 50s, though the story goes back further than that. In order to bring a little science back into the debate, a quick review of the scientific method is in order.

Very few things in this life are certain, except for death and taxes. Scientific theories are no exception—they stand, and become accepted as laws only as long as no-one manages to refute them. You do not prove a theory is correct; but if you try very hard and ingeniously to prove it wrong, without success, then the

theory may be generally accepted for the time being (Popper 1972). Ptolemy's epicyclic theory of heavenly body motions gave quite accurate predictions of the state of the sky seen at night, but the theory was wrong and eventually was replaced by a better theory. The theory has been updated more than once since.

Statistical methods play an important part in testing scientific theories, especially theories that suggest one way of doing things is better than another, or that some treatment is effective or dangerous—experiments that involve physical measurements of differences in some way. Statistics provide a way of distinguishing between differences due to chance factors (measurement error, uncontrolled factors, ...) and differences that cannot be due to chance. Science is ultimately based on probability, but with suitably large sets of data samples, the probability of being wrong can be made very small.

Suppose, for example, it was suggested that ingesting fluorides<sup>1</sup> causes or facilitates cancer growths. One might set up an experiment in which groups of animals in identical situations (genetic heritage, environment, diet, etc) were given differing amounts of fluoride in their food and water in such a way that the amounts ingested could be accurately controlled. The group receiving no fluoride would be known as the *control group* and the other groups—*experimental groups*—would receive varying amounts of the suspected substance—the *controlled variable*. A *null hypothesis* would be set up stating that the number of cancers occurring in the various groups did *not* depend on the amount of fluoride ingested.

The experiment would then run its allotted course, and eventually there would be information about the numbers and types of cancers occurring for the various groups. The numbers would vary from group to group, perhaps due to chance factors, perhaps due to the different conditions (*treatments*), and perhaps due to lack of control of the conditions. However, statistics would allow you to compare the numbers for the different groups and decide whether the variation was simply due to chance, or was too great and systematic to be due to chance and must therefore be due to the treatment.

This is what *statistical significance* is all about, and is how it is applied in scientific experiments. A difference may be observed, but it is only considered statistically significant if it is so large and systematic in relation to the treatment that the possibility of it being due to chance is very small—how small depends on the cost of being wrong, and is decided by the experimenter, using accepted norms, before the experiment is run. Statistical judgements are thus bets in a very real sense.

It is important to note that, in experiments like this, lack of statistical significance does not prove the treatment has no effect; it merely fails to show that it does have an effect with a small enough chance of being wrong. This can occur for all kinds of reasons including bad experimental design, excess natural variability for the sample sizes used, failure to control the conditions of the experiment properly, and so on. Moreover, a result may not reach the rigorous standard set for statistical significance, but still be highly suggestive of a trend that merits further investigation. A series of experiments that all showed the same trend could be very convincing even if no given

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1. *Fluorides*: a generic term referring to compounds containing the element fluorine in some form. Sodium fluoride contains 19 parts of fluoride to 23 parts of sodium.

experiment achieved the standard of significance set by the experimenter (generally a very high standard). It should also be noted that an effect can be found *statistically* significant, but may not be of *practical* significance because the magnitude of the effect is small. It depends what situation you are dealing with. However, when small effects are applied to large populations, even very small effects can be important because a large number of individuals will still be involved—0.1% of twenty million is 20,000.

One important reason for failing to achieve statistical significance is lumping things together that should be separate. Thus treating all cancers as the same in a population of animals prone to cancer might hide an effect of the treatment that would be obvious if common cancers were separated from ones that normally did not occur, and were therefore much more likely to show a pattern with the treatment if they occurred. Lumping things together can hide differences.

If fluoride merely fails to reach statistical significance as a carcinogen in a controlled, well-designed and run experiment, you may not be scientifically convinced that it is a carcinogen, but you certainly have *not* proved that it isn't. You might, in fact, still have good reason to believe that it is. If you have been careless in interpreting your data (e.g. classifying cancers of various types), you may even have hidden a statistically significant effect.

### 3. The US NTP study of sodium fluoride & cancer

The situation just described characterises the essence of the National Toxicology Program study of the effect of sodium fluoride on rats and mice (NTP Technical Report 1990), except that one set of cancer data showed a statistically significant effect of sodium fluoride in causing cancer—that is, the null hypothesis that fluoride does not cause cancer was rejected. With a very small chance of being wrong, the study showed that sodium fluoride *does* cause cancer at cumulative doses comparable to those ingested by humans over a number of years. The NTP study was contracted out to the Battelle Institute, of Columbus, Ohio, but was subsequently subjected to several levels of review and adjustment in which, against the advice of qualified experts, some rare cancer types were lumped with common cancers. Other problems such as fluorosed bones were found.

In the light of this finding of a statistically significant link between fluoride consumption and cancer, it is especially interesting that the concurrent control group animals in the study actually received non-zero amounts of fluoride in their food (8 ppm) (US DHHS Subcommittee Review 1991 p 73). Historical controls (animals used in tests on other suspected carcinogens, and much quoted to argue that the animals were inherently cancer prone, which therefore effectively hid statistical significance) received even more fluoride in their food (28-47 ppm) (US Dept of Health & Human Services Subcommittee 1991 pp 89-90). The control animals were not controls at all, but low-dose experimental animals—at least some of their cancers quite possibly due to the fluoride they ingested. This would raise the level of cancers observed in all animals and hide the effect supposedly being studied—an

obvious and serious flaw in both the experimental design and in the interpretation of the results. Drs. Carton and Marcus<sup>2</sup> noted this and a number of other problems, including the fact that many of the cancers found by Battelle's histopathologists were downgraded to commoner types, or eliminated altogether, over the objections of outside experts (Carton & Marcus 1990). Despite the manipulations, the occurrence of osteosarcomas (bone cancers—unusual for rodents<sup>3</sup>) in male rats showed a statistically significant positive relationship to fluoride dose (more fluoride, more cancers). The original unexpurgated Battelle results showed statistically significant dose-related occurrence of cancers of various sorts, including an extremely rare form of mixed bile-duct/liver cancer—hepatocholangiocarcinoma (Carton & Marcus 1990).

The osteosarcomas in male rats become even more significant in the light of an epidemiological study of a large human population by the State Board of Health in New Jersey (Cohn 1992). That well conducted and thoroughly peer-reviewed study found that males aged 10-19 were nearly 7 times more likely to get bone cancer if they lived in a fluoridated municipality than if they lived in a nonfluoridated municipality (a statistically significant rate ratio of 6.9). The general population in those areas was 5 times as likely to get it (also statistically significant). Given the large number of people in the study, and the results of the NTP study, alarm bells should have rung loudly for the US Public Health System, especially given they had previously noted a rise in such cancers for young males in fluoridated areas during the first five years of fluoridation (US Dept of Health & Human Services Subcommittee 1991 p 82). Instead, the executive summary (the only part likely to be read by important people) starts by praising the dental benefits of fluoridation, and then fails to present the results clearly.

Substance	Daily Dose (mg/kg/day)	Maximum Contaminant Level (MCL) (mg/litre)
Fluoride	7.9	4
Vinyl chloride	1.7	0.002
Carbon tetrachloride	47	0.005
Benzene	50	0.005
Chloroform	160	0.100
Tetrachlorethylene	386	0.005
Red dye #3	4000	none

**Table 1:** Comparison of fluoride dose causing bone cancer in the NTP study (top line) with doses used to test other suspected carcinogens and the Maximum Contaminant Levels allowed

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2. Dr. Carton was an EPA Environmental Scientist and Dr. Marcus was Senior Science Advisor and a trained toxicologist at the time.
3. The report actually comments on the rarity of these bone cancers in rodents on page 76.

It has been suggested that the experimental animals received abnormally high doses—so high that many common substances like sodium chloride (common salt) would show ill effects at the same dose and that in any case a person would have to drink 79 litres of water a day for life to equal the fluoride dose. Actually, as Table 1 shows, the fluoride doses were low compared to many other substances tested for carcinogenicity, where doses ranged from 6 to 500 times the fluoride dose used. Only vinyl chloride was tested at a lower dose. People regularly ingest over 100 times the amounts of common salt without ill effects. The cumulative dose of fluoride ingested by *average* people in fluoridated communities reaches the low dose rats after only 38 years; many people will equal the mid-dose rats in a lifetime, and some even approach the high dose rats (see below, pp 9-10). Citing a Scandinavian study, Danielson *et al.* say:

“Fluoridation of water supplies was initiated prior to long-term studies of its effects on bone density. Recent studies suggest that fluoride accumulates with age and may reach toxic bone levels in a person’s lifetime (at a water content of 0.97 ppm).”

Many people exceed the average, some by 6 times or more. With increasingly widespread fluoride contamination these amounts will rise, and the time to accumulate similar doses to the rats will thus fall. Marcus (Carton & Marcus 1990) quoting an earlier study notes that people accumulate up to 7,000 ppm of fluoride in their bones, when ingesting water containing 4 ppm (the EPA’s Maximum Contaminant Level or MCL), while the high dose rats had only 5,470 ppm. He comments that it is the first time he can remember test animals having lower concentrations of a suspected substance than humans at the site of adverse effect.

The NTP study did not give fluoride a clean bill of health, despite all the

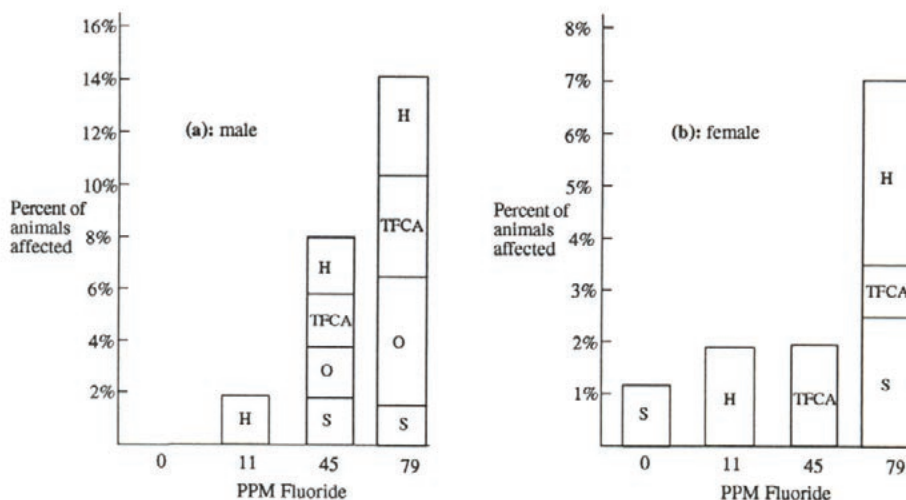


Figure 1(a) & (b): Histograms showing composites of rat neoplasms, many cancerous

H: Hepatopholangiocarcinoma S: Squamous TFCA: Thyroid follicular cell adenoma O: Osteosarcoma

reviews and corrections that acted to hide statistical significance. Fluoride’s particular affinity for bone adds to the significance of the link with bone cancers. Females were more susceptible to soft tissue cancers. The New Jersey study (Cohn 1992) also showed that fluoride affects males differently from females (which

means it is important to consider them separately in trials to avoid hiding significant effects—see Section 2). It is interesting to plot the dose-related composite incidence of neoplasms<sup>4</sup>, including those that were rejected or downgraded by the public review committee, despite the contrary evidence of appropriately qualified experts (including, for the hepatocholangiocarcinomas, the person who discovered them—Dr. Mel Reuber). Figures 1(a) and 1(b) show the plots. The trend is suggestive.

## 4. Ethics and practical significance

There is also the question of ethics and practical significance. If you are adding something to the public water supply that everybody will have to consume<sup>5</sup>, it is not enough that you were unable to show it *did* cause cancer. The onus would be on you to show that it does *not* cause cancer. Proving a negative scientifically is quite difficult, because of the demands of the scientific method. However, it is not ethical to leave the impression you have proved fluoride doesn't cause cancer when the trend is highly suggestive that it does cause cancer and at least one statistically significant result from your experiment provides scientifically compelling odds that fluoride *does* cause cancer. It is even more reprehensible to continue asserting that there is no evidence fluoride causes cancer when a reputable epidemiological study on humans (Cohn 1992) finds exactly the same sex-related cause-effect relationship for humans that appeared in the experiment on rats.

If you are adding something to the public water supply that will affect the entire population, even a very small risk can affect a large number of people. With high rates of water fluoridation (60% of North America is fluoridated), the argument that the risk may be statistically significant, but is too small to be of practical clinical significance, becomes completely unethical. And that is ignoring the amount of fluoride taken into the body through dental treatments—including fluoridated toothpaste (Minister of Supply & Services Canada 1993, p 27). This is a particular concern for children under six who swallow up to 50% or more of the toothpaste they use, which contains 1000 to 2000 times the concentration of fluoride found in fluoridated water.

## 5. Hip Fractures

The scientific case for saying the administration of fluoride is positively correlated with excess hip fractures is very solid. Ironically, “fluoride therapy” has been used experimentally as a possible cure for osteoporosis<sup>6</sup> for about 25 years, though it is not yet approved for general use. It turns out that not only does fluoride

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4. Abnormal new growths where multiplication is uncontrolled and progressive. May be benign or malignant (cancerous—having the property of anaplasia, invasiveness, and metastasis; leading to death). The data were obtained from the unpublished Battelle report.

5. Unavoidably in the prepared foods and beverages from fluoridated regions that they buy—they can obtain fluoride-free bottled water to avoid drinking the public water itself.

6. Osteoporosis is a name for loss of bone strength due to calcium depletion that particularly affects post-menopausal women.



therapy have serious side effects, but it actually causes a three-fold *increase* in nonvertebral fractures (Riggs et al. 1991). This is because, although the therapy increases bone *density*, the bone *structure* is seriously compromised, forming a coarse crystalline matrix with reduced tensile strength; but tensile strength is *necessary* to resist to bending fractures, including those affecting the hip joint.

Three other papers, all published in the *Journal of the American Medical Association*, showed statistically significant relationships between water fluoridation and increased hip fractures (Jacobsen *et al.* 1990; Cooper *et al.* 1991; and Danielson *et al.* 1992). These were major studies on large populations. The first two covered all counties in the US and a large area of Britain. The third, which was carried out in Utah, is of particular interest because the effect of confounding factors<sup>7</sup> such as smoking and coffee drinking were likely very much reduced due to the Mormon culture of the communities studied. The unanimous conclusion from the studies was that there is a significant increase in the occurrence of hip fractures amongst elderly people who have lived in regions with fluoridated water.

More recently a French study found an 86% increase in hip fracture rates amongst elderly French people living in regions with fluoride in the water (i.e. nearly double the normal rate) (Jacquemin-Gadda 1995). The above studies are in stark contrast to a US study (Pak 1994) which found fluoride therapy “inhibits new vertebral fractures, increases the mean spinal bone mass without decreasing the radial shaft bone density<sup>8</sup>, and is safe to use.” I would describe this conclusion as “weasel worded” since it avoids most of the contentious issues whilst saying that fluoride therapy is “safe”. Given the well-documented increase in hip fractures, the conclusion lends a whole new meaning to the word “safe”. The medical/dental establishment is heavily into denial, and I have heard much nonsense of the same kind, first hand, from medically qualified people who should have known better. The Pak *et al.* (1994) study has been criticised for avoiding the issue of bone quality, and for being too short for proper evaluation of the therapy due to the slow turnover of bone in post-menopausal women. What the experiment really documents is the induction of osteofluorosis as an iatrogenic<sup>9</sup> pathological condition!

It might be suggested that other factors such as variation in calcium intake were at work in these studies (confounding factors again). The French study (Jacquemin-Gadda 1995) specifically considered calcium, as well as fractures at sites other than the hip. The effect they found related to fluoride in the water causing hip fractures, with no effect either way by calcium. Sowers *et al.* (1991) also found increased hip fractures to be significantly associated with higher fluoride content of the water, and unrelated to varying calcium content. Although the fluoride content of the water in the last named study was equal to or greater than normal water

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7. Sources of uncontrolled but possibly systematic variation that could produce spurious results.

8. The radial shaft is the shaft of the radius, the larger bone in the lower arm

9. Iatrogenic—caused by doctors

fluoridation levels, the findings are significant in the light of increasing total fluoride intakes, and the elimination of low calcium as a factor causing fragility.

Taken altogether, these studies show that fluoride causes bone damage whether at therapeutic or water fluoridation levels.

## **6. Incomplete disclosure of evidence, suppression and other dirty tricks**

Fluoride promoters usually accuse people who oppose them of quoting material out of context, or incorrectly, or without understanding, when embarrassing facts are lined up against them. No doubt this happens sometimes. However, promoters invariably fail to acknowledge the evidence against them and there is excellent evidence that they ignore and suppress reputable studies and expert opinions that are unfavourable to their case, and discredit or dismiss the reputations of experts they cannot bring into line (e.g. Hileman 1988). The most blatant recent example of this occurred when Dr. William Marcus, then a Senior Science Advisor and toxicologist in the Office of Drinking Water (ODW) of the US Environmental Protection Agency, who had strongly criticised the emasculation of the NTP study results, was fired for alleged misconduct unrelated to fluoride. In the subsequent court case against the EPA by Dr. Marcus it was proven that the EPA had used false evidence in order to try to incriminate Dr. Marcus. Judge David A. Clarke Jr. declared in his decision on this case on December 3rd 1992 that “the reasons given for Dr. Marcus’ firing were a pretext ... his employment was terminated because he publicly questioned and opposed EPA’s fluoride policy.” Marcus was ordered to be reinstated, with back pay, fringe benefits and interest, attorney’s fees and was awarded \$50,000 US in compensatory damages (Carton 1993). Robert Reich, the Secretary of Labour, criticised a number of EPA managers, including the Director of the ODW which regulates fluoride levels, for acting improperly in discharging Marcus (Lowey 1994). Most people who speak out against fluoride—especially if they are experts—are trashed by promoters, in one way or another<sup>10</sup>.

Documentary evidence that promoters were “economical with the truth” and used dirty tricks from the beginning is available. One of the best known amongst those who have studied the topic dates from as long ago as 1951, just as the big push for universal water fluoridation really got going. It is a transcript of a meeting of State Dental Directors in the US at which Dr. Frank Bull, Director of Dental Education for the State Board of Health in Madison, Wisconsin, provided insights from his experience on how to get fluoridation accepted, or at least approved

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10. Climatologist Stephen Schneider puts it bluntly, advising science advocates “not to be naive about how extensive a career risk they may face.” especially if they get involved with public policy controversy. The result can be character assassination by Ph.D-wielding critics parading as defenders of the sanctity of science (Stanford U News Service 1993)

(Federal Security Administration 1951). Here are some quotes from Dr. Bull's presentation:

"Now we tell them this, that at one part per million dental fluorosis brings about the most beautiful looking teeth that anyone ever had." [p 11]

"... Dr. Bain used the term 'adding sodium fluoride'. We never do that. That is rat poison. You add fluorides . ... But this toxicity question is a difficult one." p 12]

"One thing that is hard to handle is the charge that fluoridation is not needed. They talk of other methods, and when they get through adding up all the percentages of decay that we can reduce by such methods, we end up with a minus. When they take us at our own word they make awful liars out of us. And that will be brought up." [p 15]

"Now, why should we do a pre-fluoridation survey? Is it to find out if fluoridation works? No. We have told the public it works, so we can't go back on that. Then why do we want a prefluoridation survey?" [p 17]

"The question of toxicity is on the same order. Lay off it altogether. Just pass over, 'We know there is absolutely no effect other than reducing tooth decay.' you say" ...[p 20]

"And certainly don't stress the cost." [p 20]

"Let me tell you, the PTA is a honey when it comes to fluoridation . ...They said 'What can we do?' We said, 'How many of these PTA people can you get down to your council meeting on Monday night' They didn't think they'd have any trouble getting a couple of hundred. 'Well,' I said to this dentist, 'how much does that room hold?' He said, 'Fifty.' I said, 'That will be good. Get them down.' They were down. The council pulled it out from underneath the table, and put it above board, voted, and they got fluoridation." [p 21]

Edward Bernays, Freud's nephew and the original spin doctor, would have been proud of the appropriately named Dr. Frank Bull.

A more recent example is taken from a newsletter from Partners for Better Oral Health, a coalition of fluoride promoters located in Harrisburg, Pennsylvania. It is undated, but was provided by Dr. Brent Friesen, Medical Officer of Health in Calgary, to the mayor Al Duerr on May 28th 1990, to refute citizen concerns about the NTP study. Dr. William Gross, DDS said, in relation to the dosage of NTP study test animals:

"For a human to receive the equivalent of 79 ppm of the fluoride ion at the recommended level of 1 ppm, one would have to drink 79 litres of water per day for a lifetime"

The effect of drugs and chemicals on organisms usually depends on total body weight. Doses are typically expressed as mg/kg/day. The rats did not drink a litre of water a day, but between 13 and 21 grams of water (NTP Technical Report 1990). Thus the controlled doses for the four groups of rats, based on average weights of rats, were 0, 1.3, 5.5 and 9mg/kg/day—a total dose of 0, 949, 4,015 and 6,570 mg/kg respectively over the two year period.

Rose & Marier (1977) estimated an average fluoride intake of between 3.5 and 5.5 mg daily for persons living in fluoridated regions. Take an intermediate value of 4.75 mg. Thus an *average* adult male human weighing 70 kg would be exposed to roughly 0.07 mg/kg/day (24.8 mg/kg/year)—a figure confirmed on p 85 of the NTP report. This is certainly conservative because fluoride intakes have been rising since 1977, as evidenced by the increasing problem of dental fluorosis, and

is an average for males—females' mg/kg/day would likely be higher as their body weight is lower. Many people will ingest far more than the average.

Thus 79 times the *dose* ingested by the average person in fluoridated regions would be required to equal the daily *dose* administered not to the *high* dose rats, but to the *medium* dose rats<sup>11</sup>. This is Gross mistake number 1. Apparently it leads to stronger support for his case.

However, the effect of fluoride being studied was its *chronic* (cumulative) poisoning effect, not its acute poisoning effect<sup>12</sup> because fluoride is a cumulative poison. The total *cumulative* dose depends on the time for which a daily dose is taken. The rats took it for two years (dosage figures above). Thus the *average* person living in a fluoridated region would consume the same total dose as the low dose rats in just 38 years at *one* litre of water a day. At this stage, the animals had serious dental and skeletal fluorosis, as well as assorted cancers. By the time they were elderly, the person would be well on the way towards the dose administered the medium dose rats. This is a far cry from the 79 litres of water a day that Dr. Gross claimed would be needed to equal the dose given to rats, and is Gross mistake number 2.

Actually, Dr. Gross really only made one mistake. He confused the *concentration* of fluoride ions in the water drunk with the (cumulative) *dose* administered by drinking the water. This is one of the fundamental mistakes made by nearly all fluoride promoters. It doesn't matter what the concentration in the water is if I don't drink any. Equally, if I drink a lot of water, and eat mainly foods and beverages prepared in fluoridated regions, I could easily ingest the fluoride equivalent to 10 litres of fluoridated water a day. That would be double Rose & Marier's estimate, and at 70 kg I would reach the dose administered to the *medium* dose rats in less than an average lifetime, and the high dose rats in 126 years. The world's oldest women recently died at age 120, and has been replaced by a 116 year old Canadian in the Guinness Book of Records. Many people these days, unfluoridated in their early life, are living beyond their 80s. These days they would accumulate unacceptably high lifetime doses, if they survived that long. It is very unusual (as previously noted) to test a suspected carcinogen at such low doses compared to human exposure. However, the researchers could not administer higher doses because of the adverse effects on the animals' health (NTP Technical Report, p 41).

The misrepresentation of the main NTP study results has already been touched on. It is particularly bad to misrepresent evidence against fluoride in a report that specifically addresses the question of its risks and benefits. In the subsequent review, which further downgraded<sup>13</sup> the findings of the NTP study (US

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11. (Dose for medium dose rats)/(average human dose) = 5.5/0.07 = 79)

12. Its acute effects are well known. Fifty parts per million in the water is considered by doctors dealing with real situations to be a lethal concentration (Stock 1992) whilst 50 mg/ kg-body-weight of fluoride, administered in one dose (3.5 grams for a 70 kg person), is considered a certainly lethal dose by toxicologists (Hodge 1979). For a 10 kg child, the certainly lethal single dose would be 500 mg, an amount about the size of a pea.

13. The draft report (NTP Technical report 1990) was already watered down from the original Battelle study report by one review committee, as noted (Carton & Marcus 1990)

DHHS Subcommittee 1991) the Riggs *et al.* (1990) study on fluoride treatment for postmenopausal women is referenced on page 41. The discussion fails to mention the statistically highly significant threefold increase in non-vertebral fractures in the experimental (fluoride-taking) group, compared to the placebo (non-fluoride) control group, and concentrates instead on the lack of difference in vertebral fractures and changes in bone mineral density—an effect of iatrogenic osteofluorosis that we have already discussed. Moreover, the subcommittee report specifically and incorrectly states, without qualification, that “hip fractures did not occur at different rates between groups” when there were seven complete hip fractures in the fluoride group but only three in the control group. Two from each group died, partly as a result of the fractures. The difference in number of fractured hips may not have reached the level of statistical significance set for the particular experiment, but to *deny* they occurred is to hide an obvious trend which should certainly not be ignored—given the results of related experiments, and the statistically highly significant difference in total non-vertebral fractures.

Other misleading statements occur elsewhere. For example, on page 64 the subcommittee quotes a study of two teenage patients who drank water containing between 1.7 and 2.6 ppm of fluoride, who developed fluorosed teeth and bones, and who suffered renal (kidney) failure (Juncos & Donadio 1972). On the following page, in the summary of this same material, it ignores the previous statement and says “the overall health significance of reduced fluoride clearance is uncertain, with no cases of symptomatic skeletal fluorosis being reported among persons with impaired renal function.” Renal failure is the ultimate in impaired renal function! Clearly there are question marks concerning the health of people with renal problems who drink fluoridated water.

Then, in discussing mutagenicity (the ability of fluoride to damage genes), the report says “Sodium fluoride inhibits both protein and DNA synthesis in cultured mammalian cells . . . Fluoride can react with [elements] in the cell so as to affect enzyme activities that are necessary for DNA or RNA synthesis, or chromosome metabolism or maintenance; . . . or it can disrupt other cellular processes such as cellular differentiation or energy metabolism . . .” But in the summary on the next page, it goes on: “Genotoxicity studies of sodium fluoride often show contradictory findings . . . The most consistent finding is that fluoride has not been shown to be mutagenic in standard tests in bacteria (Ames test)” even though admitting that fluoride “has been reported to induce mutations and chromosome aberrations in cultured rodent and human cells” (pages 70-71 and 89 of the same subcommittee report).

What they do *not* say is that, in the NTP study they are supposed to be reviewing (NTP Technical Report 1990), four kinds of tests for mutagenicity were carried out—including the Ames test, and *three out of the four came up positive*, showing fluoride is mutagenic. Only the Ames test came out negative. The weight of evidence says fluoride is mutagenic. What makes this kind of misdirection particularly unacceptable is that Bruce Ames, the inventor of the Ames test, is on record as stating that the test is not appropriate for fluoride for technical reasons

(Carton & Marcus 1990—Ames' letter was introduced into the congressional record by Arthur Upton). Mutagens are usually also carcinogens. Although the results of the mutagenicity testing appeared in the body of the original NTP study report, they were excluded from the executive summary, despite their obvious relevance and importance.

Frank Young, the chairman, admitted that the review committee had zero members opposed to fluoride on it, while many were enthusiastically pro-fluoride (Young & Yiamouyannis 1991). When pro-fluoride experts overlook or misrepresent parts of the very material they quote, when it is against them, one wonders how much other material was passed over without proper assessment.

## 7. Effects on reproduction

The same PHS report (US DHHS Subcommittee 1991) admits that the effects of fluoride on reproduction needs further study (p 88). In the W.S. Meader fish hatchery suit against fluoride-polluting industries in 1961, over \$60,000 US in damages were awarded—equivalent to around half a million dollars in today's money. The court records report that “the eggs were worthless” and did not hatch properly, while the fish exhibited malformations. Fluoride levels in the water were between 0.5 and 4 ppm (Waldbott *et al.* 1978, p 296).

The US Department of Health and Human Services Subcommittee report (1991) states clearly, on page 87:

“Several species are sensitive to fluoride levels higher than those normally encountered, such that their fertility and reproductive performance is impaired. The potential for adverse reproductive effects of fluoride exposure to humans has not been adequately evaluated.”

There have been a number of news reports of declining sperm counts and seminal volumes for humans over the last 50 years, perhaps reflecting a drop in male fertility, whilst there has been a sharp increase in male genital cancers over the same period (e.g. Mihill 1992). It is suggested that environmental pollution may be responsible. A possible role for fluoride has not been considered, and other chemicals were introduced widely over the same period as the declining sperm counts and the introduction of fluoridation. Nevertheless, it would certainly seem prudent to check out these suggestive correlations in view of the importance of the matters involved, and the lack of previous research, especially given the known effects of fluoride in interfering with DNA, RNA and cell metabolism. In this connection, another report is of interest. Apparently organic farmers have about double the current average sperm density (Reuters 1994). One of the known effects of pesticides is to contaminate the treated produce with fluoride (Stannard *et al.* 1991). Organic farmers have a particular commitment to avoid any involvement with pesticides, and very likely consume, as well as produce, only organic produce.

Freni (1994) found increasing fluoride decreased birth rates. It is an understatement to say that the effects of fluoride on reproduction need further study!

## 8. Reduction of tooth decay and related matters

The supposed reduction of tooth decay due to the use of fluoride and especially water fluoridation is the core of the fluoride promoters' case for making fluoride the privileged pollutant that it has become, and for pushing it on communities whether or not they want it. For example, California has recently made water fluoridation mandatory without an appropriate vote. What you believe depends on who you listen to.

During 1986-87, in a survey of 39,207 children between the ages of 5 and 17, the US National Institute for Dental Research (a long-time advocate of water fluoridation) found children living in fluoridated areas had 18% less tooth decay than children living in non-fluoridated areas, based on Decayed, Missing and Filled tooth Surfaces (DMFS). Additional corrections raised this to 25%. The first point to note here is that this is a far cry from various earlier claims that originally put the figure at up to 75% reduction, or even claimed that fluoridation eliminates tooth decay<sup>14</sup>.

The NIDR seemed reluctant to release the data for the above study, which were subsequently obtained under the US Freedom of Information Act (Yiamouyiannis 1990). Careful re-analysis of the data brought Dr. Yiamouyiannis to a strikingly different conclusion from that reached by the NIDR. He found no statistically significant difference between the age adjusted Decayed, Missing and Filled Teeth (DMFT) rates<sup>15</sup> for permanent teeth between the fluoridated, partially fluoridated and non-fluoridated groups in the study at any age in the 84 areas throughout the US. An analysis of the ordering of these areas by DMFT rate in permanent teeth showed no statistically significant rank order effect—that is, there was no clustering of decay or lack of decay according to the level of fluoride, and no trend for fluoridated, partially fluoridated or nonfluoridated regions to occupy any particular areas of the rank-ordered table. In plain terms and with high confidence, being fluoridated or not fluoridated did not affect DMFT rates. The one finding that was in favour of fluoridation concerned lower DMFT rates for 5 year old children living in fluoridated regions. This is consistent with the *documented effect of fluoride in delaying the eruption of deciduous teeth* (Waldbott 1978 p 186)—the teeth had not erupted as early, so could not suffer the DMFT effects to the same extent.

Dr. John Colquhoun, one-time Principal Dental Officer for Auckland, Chairman of the Fluoridation Promotion Committee for the New Zealand Dental Health Foundation, and President of the New Zealand Society of Dentistry for Children set out to prove once and for all the benefits of water fluoridation based on analysing the dental records of New Zealand children (which were very

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14. As recently as 1989 when Calgary Health Services were promoting fluoridation, they placed an advertisement in the Calgary Herald claiming *both* a possible reduction of 50% in the tooth decay rate *and* that tooth decay could be “extinct” (like the dinosaur) if the Calgary water was fluoridated (Calgary Health Services 1989).

15. DMFT has been the more usual measure for tooth decay.

comprehensive). The results shocked him and caused him to change his stance, since he found no statistically significant effect either way. The caries rate was just as likely to be higher in fluoridated regions as in non-fluoridated regions. He was eased out of his appointments as a reward! Dr. Richard Foulkes who recommended water fluoridation in BC in 1973 underwent a similar conversion when he discovered the facts. He said he had been “snowed”.

Colquhoun went on to write up and publish his results (Colquhoun 1985; 1987). The earlier study even found evidence that caries rates might be higher in fluoridated regions. The later study covered 98% of the New Zealand children aged 5-13 and 68% of the pre-schoolers with the result already mentioned.

Colquhoun’s study has been criticised because it used tooth filling rates, reflecting NZ dental practice, rather than the usually accepted DMFT. The 1986-87 NIDR study used DMFS as already noted.

Other similar studies in recent times have supported the view that there is little if any difference in tooth decay rates between fluoridated and non-fluoridated regions (Diesendorf 1986, 1990; Gray 1987; Hildebolt 1989). Gray, who was Director of Dental Health Services for British Columbia, found that the DMFT rates in British Columbia, which was only 11% fluoridated, were lower than the other Canadian provinces which are 40-70% fluoridated. He commented that:

“A 60% reduction in DMFT rate of children when the average DMFT rate is 8-10 teeth is very significant. A 60% reduction in the DMFT rate when the average DMFT rate is less than 4 teeth is of less significance. If the reduction that is occurring through fluoridation is not 60% but closer to 25%, then it is something else again. There are significant costs to purchasing, operating, maintaining and replacing equipment and supplies. Perhaps the greatest cost to the community is the emotional upheaval that a fluoridation referendum causes in the minds of some of its residents. These are points that need to be considered when community fluoridation is proposed, and balanced against the benefits to be derived.”

Gray goes on to suggest that, now that we know more about the likely mechanisms involved in tooth decay, fluoride toothpaste should be considered more appropriate than fluoridation in these changing times. Colquhoun (1990) says categorically that brushing it on is better. Gray subsequently felt obliged to write a letter stating that he still supported water fluoridation (Gray 1988).

Fluoride promoters frequently confuse the issue of *topical* application of fluoride (applying it to the teeth directly — in principle, external application; in practice, varying amounts are swallowed or absorbed through the mucous membranes), with *systemic* treatment (taking it internally — eating and drinking it). The successful fluoridation plebiscite in Calgary in 1989, after five previous rejections, was mainly founded on just this confusion. A dental hygiene unit was prepared for schools in Calgary by the Calgary Health Services in conjunction with teachers from the Calgary School Board (Calgary Health Services, undated). Students were invited to paint an egg with sodium fluoride (topical application) and then invited them to draw positive conclusions about water fluoridation (systemic application) for their community.

It was these students who supposedly petitioned City Hall to hold another plebiscite on fluoridating Calgary. I have seen the letter in the city archives and it



was actually signed by the teacher who ran the class. The possibility that eggs and teeth do not react in quite the same way was not discussed, nor was the difference in application techniques, nor the political and ethical implications. No possibilities of harms (such as fluorosed teeth) were discussed, and opponents were caricatured in an unfavourable manner. Few people would quarrel with a person's right to brush their teeth<sup>16</sup> with whatever substance they feel is best for them, including fluoridated toothpaste. However, the lesson promoted water fluoridation based on an abuse of the scientific method, and a totally one-sided and ill-founded view of the risks and benefits. It effectively did not deal with the medical, moral and political issues at all, and it discredited, by association, those with opposing views.

At current DMFS/DMFT rates, even the most optimistic estimate of the effect of water fluoridation made by the NIDR—an organisation that has consistently promoted water fluoridation for more than 45 years, is a reduction from around four or five cavities to around three or four cavities—a 25% reduction in affected tooth surfaces. The same data says that the difference in the number of *teeth* affected by decay is zero, a finding confirmed by the other studies cited.

## 9. In conclusion: medical, moral, economic, legal and political issues

From a medical point of view, water fluoridation makes little sense. People's water intake varies a great deal. More importantly, since water is so widely used in the food and beverage processing industry, the fluoride intake from fluoridated water is not confined to the water people drink. In the overview of their classic work on fluoride, Rose and Marier (1977, pp 108-110) said:

“There is no doubt that inadequate nutrition increases the severity of fluoride toxicosis”<sup>17</sup>

“Fluoride has displayed mutagenic activity in studies of vegetation, insects, and mammalian oocytes”

“Long-term ingestion, with accumulation of fluoride in animals and man, induces metabolic and biochemical changes, the significance of which has not yet been fully assessed . ... There is evidence that neurologic complaints are related to the early histologic changes that precede overt skeletal fluorosis.”

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16. It is worth mentioning that young children are estimated to swallow at least one third of the toothpaste they use. Since toothpaste contains at least 1000 and as much as 2000 times the concentration of fluoride that fluoridated tap water contains, the 1 gram typically used to brush the teeth contains as much fluoride as one or two litres of the water, and is in addition to all other sources. When fluoride was first added to toothpaste, warnings were printed on the tubes and boxes. Such warnings are now being issued by concerned fluoridation proponents in the face of rising rates of dental fluorosis (up from 10% in the 50s to 30-80% in modern times). Dental fluorosis is regarded by some experts as the first sign of systemic fluoride poisoning. The ridiculous aspect of this is that much of the fluoride intake these days is the uncontrolled intake due to processed foods and beverages from fluoridated regions for which the only cure is not to fluoridate the water—the opposite of what promoters wish to achieve.
17. So, far from being of most “benefit” to poor people, fluoride is likely most harmful.

“Fluoride is a persistent bioaccumulator, and is entering into human food-and-beverage chains in increasing amounts. Careful consideration of all available data indicates that the amount of fluoride ingested daily in foods and beverages by adult humans living in fluoridated communities currently ranges between 3.5 and 5.5 mg. For a 70 kg human adult, this range is close to the 0.03 to 0.07 mg/kg/day estimated for ‘an acceptable daily intake’. In addition to the food chain, dentrifices and pharmaceuticals can contribute significantly to the fluoride intake of some individuals.”

“In addition to industrial workers, there are several sub-groups of the population who may be more affected by environmental fluoride than the population at large.”

Some people, by accident or design, make life choices that avoid many sources of fluoride (purchase of organic foods, minimal use of prepared foods, bottled or other water supplies free of fluoride ...). Dose equals concentration times volume when you calculate medication. To fluoridate a community water supply as a means of providing a dose of fluoride is like a doctor handing out dangerous drugs at random: “Here, take a few of these tablets, they’ll do you good”. Such medication is uncontrolled, unsupervised and not subject to informed consent—especially when the risks are hidden. Do you know which cities are fluoridated in your country?

Then there is the moral aspect. Some children will be harmed, requiring corrective dentistry for fluorosed teeth. There is good evidence of other harms, such as increased hip fractures in the population, and increased cancer rates, as discussed. The most chilling recent result was a study (Mullenix *et al.* 1995) which showed various neurologic effects in rats<sup>18</sup>. The effects depended on the timing of exposure and ranged from behaviour typical of drug-induced hyperactivity, to behaviour-specific changes related to cognitive defects. The effects were age and sex-related, and were associated with elevated fluoride levels in brain areas corresponding to the behaviours. Should you be forced to take medication because I have a medical problem—especially if my medication may cause medical problems, or worse<sup>19</sup>, for you? Especially if my medication has unknown effects on your reproductive and intellectual performance!

From an economic point of view there are problems. Gray noted the costs of installing, maintaining and running the fluoridation facilities themselves. When Calgary decided to fluoridate its water, the annual running costs for water fluoridation for that one city were estimated at \$230,000 CDN per year just for the chemicals<sup>20</sup>, of which 99.9% was destined not to be drunk, but to be flushed straight down the sewers. Overall, 150 tonnes of fluoride will be dumped into the Bow River and the environment each year (the city uses over 600 tonnes of 25% hydrofluosilicic acid every year [Jamieson 1990]). For comparison, at the same

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18. Rats are considered a good model of the human for such purposes by medical researchers, just as they are for cancer studies.

19. On Friday May 22nd 1992, Dominic Smith of Iloilo Bay, Alaska, died of an overdose of fluoride from the village's public water supply after an equipment failure that raised the fluoridation level to between 57 and 150 ppm. The medical director for the region stated that levels in excess of 50 ppm could be lethal. (Stock 1992; McMahon 1993). “Doctors said they were skeptical that so much fluoride was in the water that it caused a death and widespread illness so quickly.” (Hulen 1992)

time the Reynolds Aluminium Company in Baie Comeau, Quebec, was only allowed to discharge 36.5 tonnes (100 kg/day) of fluoride into the St. Lawrence river each year under pollution control regulations (Picard 1989). The Bow river is a major trout river and fluoride is harmful to fish spawning, hatching or growth (Waldbott et al. 1978). It is a pollutant (Hammer 1983). Why does the city pay to help polluting industries get rid of their toxic industrial waste and risk damaging such an important resource?

Hip fractures are a serious and very costly community health problem. Kleerekoper (1992) quotes a US DHHS directive to reduce hip fractures by 15%. Danielson *et al.* (1992) quote the annual cost of hip fractures in the US as \$7 billion US, so a 15% reduction would save over \$1 billion. Factors which increase hip fracture rates by even small amounts will cost many millions (even for Canada) at a time when health care costs have been cut to the bone (no pun intended). Chrischilles *et al.* (1994) quote \$45.2 billion US as the cost of osteoporetic fractures of the forearm, spine and hip, describing the estimate as “conservative”. Hip fractures are especially expensive as they are most frequent amongst the over 65s and involve extensive nursing home utilisation, but, given the findings of Riggs *et al.* (1990), the whole \$45.2 billion cost is the relevant total one ought to worry about in terms of the effect of fluoride on increasing the fracture rates.

Then there are the costs of other medical and dental problems. And not just problems caused by fluoride from water fluoridation. In a recent trend-setting case in Britain, Colgate-Palmolive paid an out-of-court “goodwill” payment of £1000 sterling (\$2300 CDN) to the parents of a 10 year old boy in Essex who was diagnosed by an independent specialist as suffering from dental fluorosis caused by fluoridated toothpaste. Lawyers observing the payout said the settlement was a significant breakthrough, even though the manufacturer has denied any liability and is refusing to discuss the case (Individual Inc. 1996). In the same news service article, David Kennedy DDS, past president of the International Academy of Oral Medicine and Toxicology is quoted on the absurdity of saving less than one filling<sup>21</sup> by paying thousands of dollars for crowns and veneers. Multiplying those kinds of costs by the numbers involved soon produces millions of dollars, not to mention the effect on the victims and their loss of time.

However, the real economic aspect of fluoridation is not concerned with the costs, benefits, harms or any other aspect of people’s teeth. It has to do with solving an industrial problem. The solution involves political aspects as well and the whole story is too long to include here, but a very brief summary is provided as Appendix A. In essence, there is strong circumstantial evidence that propitious circumstances, and a little encouragement of the “right” research lines, coupled with considerable

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20. Then there was the cost of amortising the \$1.2 million capital equipment expense, plus staff and maintenance costs. These likely should have included the new plastic-lined water pipes laid by the city. The city has denied there is any connection, but the old cast iron pipes were susceptible to corrosion caused by the water fluoridation, as had been found in US cities (e.g. Seattle), and the timing of the replacement was most fortuitous.

21. If the claimed benefits truly occurred. As noted, studies show they don’t-so there are likely no reduction in total fillings at all.

political clout, allowed polluting industries to deal with their serious problems in disposing of highly toxic fluoride byproducts by selling them as tooth decay preventatives. This strategy was based on “research” and “trials” which would not be accepted as scientifically sound by today’s standards.

The legality of water fluoridation is interesting. In Allegheny County, Pennsylvania, it was tested in front of Judge Flaherty, now a Justice of the Supreme Court of Pennsylvania (Flaherty 1979, 1988, 1996). He found that:

“the evidence is quite convincing that the addition of sodium fluoride to the public water supply is extremely deleterious to the human body”

and wrote that:

“what I have read [since] convinces me all the more that in-depth, serious scientific effort should be undertaken before further expansion of this questionable practice. Those who belittle critics of fluoridation do the public a misservice, yet it seems in the face of strong, uncontradicted *prima facie* evidence, that is the tactic most often employed”.

The injunction obtained in his court against water fluoridation was, in fact, set aside by a higher court. However, it was set aside on the legal technicality that water fluoridation is a legislative matter, and beyond the jurisdiction of the courts. The same jurisdictional argument prevailed when a legal challenge to fluoridation was mounted in Calgary, based on a properly constituted petition signed by more than 45,000 citizens. The scientific case against fluoridation, proven in Flaherty’s court, remains unchallenged, and there is now much more evidence on that side.

In conclusion, there is a political aspect. People in a free society have a right to choose whether or not they will accept medication, and they have a right to individual treatment and monitoring. Those who believe fluoride works are entitled to their opinion. They may choose their own experts and distrust the proven evidence of legal proceedings in court. They may ignore their own peer-reviewed medical journal reports showing significant and serious risks. That is their right. But they have *no* right to force others to drink or use fluoride against their will, especially in the face of so much credible evidence of harms, with little or no benefit, and when more effective, democratic and medically responsible forms of medication exist. Nor should they promote the use of fluoride without reference to its dangers.

The only people who truly benefit from the widespread use of fluoride for “dental” purposes are the big industries that generate fluoride as a waste product. They not only solve their pollution problems, but make a handsome profit by selling their toxic residues to be eaten, drunk, and spread on teeth by an unsuspecting population governed by gullible officials.

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- GRIFFITHS J (1992) Fluoride: commie plot or capitalist ploy. *Covert Action* **42**, Fall, 26-30 and 63-66 (Joel Griffiths is a medical writer living in New York who has written for the Medical Tribune. (This paper is a comprehensive overview of the political and scientific aspects of the fluoride controversy from a North American perspective)
- LEGISLATIVE ASSEMBLY FOR THE AUSTRALIAN CAPITAL TERRITORY (1991) *Inquiry into the Water Fluoridation Act*. (Standing Committee on Social Policy, Chairperson W [Bill] Woods) (This report is really two reports, providing a balance between the opposing forces because of the dissenting [minority] report by Dennis Stevenson, MLA, included as Appendix 6 on pages 133-309. There is a wealth of information for both sides. The final recommendation of the committee was to *halve* the concentration of fluoride added to the water [sic])
- NATIONAL ACADEMY OF SCIENCES (1971) *Biologic Effects of Atmospheric Pollutants* (Committee on the Biologic Effects of Atmospheric Pollutants, chairperson JJ Vestal), Washington, DC: National Academy of Sciences, 295pp
- NATIONAL HEALTH & MEDICAL RESEARCH COUNCIL OF AUSTRALIA (1991) *The Effectiveness of Water Fluoridation* (Working Group, Chairperson Prof AJ McMichael), Canberra: Australian Government Publishing Services, 193pp (Statement of the official view: “fluoridation ... has ... conferred substantial protective benefit”, “Fluoridation ... remains the most effective and socially equitable means of achieving community-wide exposure”, “There is no evidence of adverse health effects”.
- VARNEY W(1986) *Fluoride in Australia: a case to answer*. Sydney: Hale & Iremonger PTY Ltd, GPO Box 2552, Sydney, Australia, 195pp (The book is a succinct, revealing summary of the politics and history of fluoridation in Australia from when it started until the date of publication)



## Appendix A: A brief look at the industrial connection

(Levy's paper (1994) and the book by Waldbott *et al.* (1978) have provided valuable detail for this appendix)

Companies that generate fluoride compounds as a byproduct of their operations were forced to clean up their effluent (gaseous in the case of Aluminum smelting) following successful and expensive lawsuits in the latter half of the nineteenth and on into the 20th century seeking compensation for environmental damage of various sorts, including the ruination of farm livestock that ate fodder contaminated by fluoride<sup>1</sup>. The Aluminum Company of America (ALCOA) was owned by the Mellon family, especially Andrew Mellon, who served as Secretary of the Treasury between 1921 and 1932, a job which placed him in charge of the US public Health Service. Around this time, a number of researchers were looking at the relationship between minerals in water supplies and effects on teeth, especially caries (decay) and mottled teeth and disfigured teeth—known in some regions as “Colorado brown stain” or “Texas teeth”. In 1931 three groups, including Churchill's group at the Mellon Institute<sup>2</sup> showed that fluoride was responsible for the disfigured teeth (Waldbott *et al.* 1978). Trendley Dean, first Director of the National Institute for Dental Research (NIDR), took up this finding and ran with it<sup>3</sup>. In the process, he and others came to the conclusion fluoride was also linked to lower caries rate, but without taking proper account of other minerals in the water, or dietary effects<sup>4</sup>.

In the mid 30s, Dr. Gerald Cox, a researcher at the Mellon Institute began lauding the benefits of fluoride in the water and conducting experiments. In 1939 he published in the *J Dental Research* (Cox *et al.* 1939) to the effect that “fluorine is responsible for the increased resistance to caries ... the case should be regarded as proved” and was the first to recommend the artificial addition of fluorides to drinking water. His experiments were based on unscientific data and analysis. For example he did an 8-week [sic] study of pregnant female rats fed varying amounts of fluoride which was methodologically and statistically unsound. (Yiamouyiannis 1986). Many experts made gloomy predictions about the consequences of adding fluoride to water supplies. Philip Sutton's book (Sutton 1959) documents problems with such early “experiments” and the later “trials” on selected North American cities in which there was an unreasonable rush to judgement on the benefit of water fluoridation and a

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1. “Airborne fluorides have caused more damage to domestic animals than any other air pollutant” (US Dept of Agriculture 1972)
  2. The Mellon Institute was typical of research institutions run by industrial consortiums for their own purposes (e.g. Kettering Laboratory at the U Cincinnati) and was privately funded by the Mellon family. In 1967 the Mellon Institute merged with the Carnegie Institute of Technology (which included the Margaret Morrison Carnegie Institute) to become Carnegie-Mellon University.
  3. Dr. H. Trendley-Dean published the results of an experiment showing the “dose-related” incidence of dental fluorosis which reached 100% at a fluoridation level of 4 ppm (TrendleyDean *et al.* 1937). As Dr. Thomas Levy comments, it is ironic that the only “dose-related” effect of fluoride on dentition that has been clearly documented is disfigurement of children's teeth (Levy 1994). Of course, the dose really depended on the water actually drunk.
  4. For example, in 1942, Hereford, Texas was dubbed “the town without toothache” because of low tooth decay rates. The water contained 2.3-3.2 ppm fluoride but also generous amounts of calcium, magnesium and other minerals, while the wheat grown in the area was particularly rich in these minerals as well as phosphorous, all of which are good for teeth. Hereford's dentist opined that the role of fluoride was greatly overplayed (Waldbott *et al.* 1978 pp 191-192)

lack of scientific method, not to mention a lack of ethics in experimenting on human populations without informed consent.

Waldbott *et al.* (1978) provides an excellent summary of the history, trials, and pros and cons of fluoride as they appeared at the time.

At first the proposal to add fluoride to water supplies was greeted with incredulity and opposition by doctors and dentists, who regarded fluoride as a dangerous “protoplasmic poison” (Editorial 1943; Editorial 1944), because of its effect on cell metabolism and its role in fluorosis. But a few years later, they suddenly switched and began promoting it as already noted (see, for example, the quotes from Dr. Frank Bull in Section 6).

Interestingly, Oscar Ewing, a lawyer and powerful political figure previously fingered by Congressman Dr. AL. Miller as a likely key player in driving the entire fluoridation campaign was (Miller alleged) paid a \$750,000 fee<sup>5</sup> by industrial interests, including ALCOA, to leave his lucrative Wall St. law practice to become head of the Federal Security Administration<sup>6</sup>, in charge of the US Public Health Service, the Social Security Administration and the Office of Education. Despite opposition from the American Medical Association and its head Dr. Morris Fishbein, Ewing was politically powerful enough to push the fluoridation campaign to its successful conclusion of full acceptance, commitment and promotion by the medical-dental establishment. The current target is 100% fluoridation of North America by the year 2000.

Miller pointed out that neither the US Public Health Service nor the dental profession had done research of their own on which to base their reversal of position, and expressed his opinion that the USPHS had misled all concerned without providing facts. He went on (Miller 1952):

“I sometimes wonder if the Aluminum Company of America, and its many subsidiary companies, might not have a deep interest in getting rid of the waste products from the manufacture of aluminum, because these products contain a large amount of fluoride. In this connection it is interesting to know that Oscar Ewing, who now heads up the Federal Security Administration (parent organization of the USPHS), and *the firm of attorneys he was with—Hubbard, Hill, and Ewing—represents the Aluminum Company of America.*” [Italics added]

ALCOA is not the only company with a fluoride byproduct disposal problem, so others would undoubtedly be supportive of any economical solution. In a letter in response to an enquiry, the Deputy Assistant Administrator of the US Environmental Protection Agency stated that:

“In regard to the use of fluosilicic acid as a source of fluoride for fluoridation, this agency regards such use as an ideal environmental solution to a long standing problem. By recovering byproduct ... air and water pollution are minimized, and water utilities have a low-cost source of fluoride available to them.” (Hammer 1983)

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5. This fee would be at least 10 times that figure in today's dollars.

6. The Federal Security Administration sponsored the Fourth Annual Conference of State Dental Directors at which Dr. Frank Bull made his presentation on how to promote fluoride.