

Mercury Dental Amalgams: The Controversy Continues

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I: The Danger in Our Mouths

The use of mercury in dental amalgam fillings has been an accepted practice in the United States for more than a hundred years. So it should come as no surprise that most people assume the silvery-looking fillings in their mouths are safe and nontoxic, posing no risk to their health. But is this assumption well founded? An analysis of the scientific evidence on mercury can only lead to a resounding “no.”

Mercury is a toxic heavy metal that can have disastrous health effects. Research shows that mercury is associated with disorders such as multiple sclerosis, Alzheimer’s disease, depression and reduced immune functioning. Mercury exposure also presents a risk to fetuses in mothers who have amalgam fillings. California recognized this risk in November 2000 when it became the first state to require dentists to inform their patients that amalgam fillings may cause birth defects.

It is of interest that the studies proving mercury’s toxicity often come from the journals of conventional dentistry and medicine. Even so, orthodox dentistry continues to assure us that the mercury in our mouths is safe. This disconnect between our long-standing assumption that mercury amalgams are nontoxic and the evidence showing otherwise reminds us of an important principle: What has been accepted as true is not always so scientifically.

The Amalgam Controversy

Dental amalgam is not the first supposedly “safe” product to generate controversy. Over the past few decades Americans have been besieged by a series of man-made health epidemics, and in each case the gov-

ernment and its watchdog agencies routinely assured us that a danger did not exist. Because they would not allow harmful foods, chemicals or drugs on the market, the reasoning went, the very fact that the products were in use assured us of their safety.

When overwhelming evidence proved the contrary, government and industry only begrudgingly removed these products from shelves. The epidemics in question? Diethylstilbesterol, a medication that harmed millions of Americans; Oraflex, an anti-arthritis drug; DDT, a pesticide; and the Dalkon shield, to name just a few of more than 200 such items that received an official stamp of approval over the years.

Now the battle line has been drawn over the mercury amalgam used in dental fillings. On one side of the battle are the scientists, holistic dentists and health activists who believe mercury amalgams are a biological time bomb ticking away in our mouths. They point to scientific evidence showing that chronic mercury exposure from dental fillings puts most people at risk of serious health disorders.

On the other side is the dental establishment, led by the American Dental Association, which claims that mercury amalgam has adverse effects only on those people who are hypersensitive to it. The ADA pegs this group at 1% of the population (a figure disputed by research). For the rest of us, it says, amalgams pose absolutely no harm.

The ADA has yet to offer scientific proof of mercury’s safety, however, leading health advocates to call for a ban on its use. The Toxic Element Research Foundation (TERF) claims that the cumulative effects of mercury amalgam poisoning make it one of the most insidious health hazards facing Americans today.

“The true impact of amalgam poisoning is similar to that of the Chernobyl trag-

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edy,” states the organization. “The magnitude of the crisis is not the few who have died from massive exposure, but rather it is the millions whose health will be eroded by the ongoing, small-dose poisoning.”¹

Considering that 19 out of 20 Americans suffer from dental cavities, the stakes are high indeed. More than 200 million people already have at least one cavity filled with mercury amalgam.² Little wonder that Americans are demanding a much more persuasive answer to the fundamental question, Are mercury amalgams safe?

A History of Ill Effects

Mercury has a long history of extreme toxicity, which makes its deliberate use in people’s mouths all the harder to comprehend. Consider the bare facts: One of the oldest of all recognized poisons—a metal more toxic than lead and even arsenic—is the main ingredient in today’s most common dental amalgam, which American dentists place in about 1 million fillings per day.^{3,4} Disinfectants, antiseptics, pesticides and insecticides contain this same ingredient because it is hostile to life.⁵

Tales of mercury’s damaging effects date to ancient Roman and Spanish history, when imprisoned slaves who worked in mercury mines developed highly common symptoms of mercury poisoning. These symptoms included lesions of the nervous system such as erethismus mercurialis (moodiness and other mental disturbances) and tremor mercurialis (involuntary, choreatic shaking movements). The slaves eventually wasted away in the terminal stages of mercury poisoning.⁶

Another example of mercury’s dangers comes from the British hatmaking industry of the late 19th century. At the time, the expression “mad as a hatter” characterized workers who used mercury compounds in the shaping of felt hats. The workers exhibited unusual shyness, mood swings and a dwindling intellect.⁷ These dangers were recognized for three-quarters of a century be-

fore the use of mercury in the U.S. hatmaking industry was banned in 1941.⁸

Mercury got its start in the dental industry in 1826, when a Parisian dentist combined it with silver, copper and other metals to create a paste. Seven years later, two brothers in New York City with no dental training began to promote mercury as a cheap alternative to gold fillings.⁹ By the end of the 1830s, the use of mercury amalgam was commonplace in the United States. Not only was the material cheap and durable, but it also required less time and skill to place than the trickier gold fillings.^{10,11}

Still, traditional dentists were appalled by the very idea of using a known poison in the body.¹² In the 1840s the American Society of Dental Surgeons required its members to sign a pledge not to use the substance in their practices. Many members refused to sign, however, because they believed mercury’s low cost would benefit the poor. The debate caused such a schism in dentistry that the Society eventually folded.

When the American Dental Association (ADA) formed in 1859, it took a very different position on the mercury issue. The ADA defended the use of mercury amalgam, helping to establish it as a popular dental filling by the end of the 1800s.¹³

The Ada’s Position on Mercury

The ADA’s staunch defense of mercury continues to this day. According to a 2001 article in the *Journal of the American Dental Association*, “Amalgam restorations remain safe and effective. Dentists should educate patients and other health care professionals who may be mistakenly concerned about amalgam safety.”¹⁴

Over the years, the association has claimed that mercury, which makes up about half of dental amalgam, becomes nontoxic as part of the larger mix of metals. In 1984 the ADA proclaimed, “When mercury is combined with the metals used in dental amalgam, its toxic properties are made harmless.” As a result, it said, “For

most patients...dental amalgam remains a safe and effective material for filling cavities.”¹⁵ In addition, a 1991 document counsels dentists to tell patients who express concern about the mercury in amalgam fillings that “...the mercury forms a biologically inactive substance when it combines with the other materials used to produce the amalgam.”

A somewhat bizarre variant of this explanation is cited by Dr. Hal Huggins, D.D.S., in his recent expose of the amalgam controversy, “Integrity vs. Intimidation.”¹⁶ In the ADA’s Guide to Dental Materials and Devices, the reader is informed that amalgam does release small amounts of mercury, but that “this evaporation stops as soon as the filling is coated by saliva.”¹⁷

“Most scientists from physics chemistry and toxicology would tell you,” Huggins comments, “that when multiple metals are warmed up to mouth temperature and coated with an electrolyte like saliva, you have a perfect condition to form a battery. In this case, the efflux from this filling-battery would be mercury, either as vapor, inorganic mercury...or methylmercury.”¹⁸

The assurances provided by the ADA have no basis in scientific fact. To the contrary, they frequently fly in the face of scientific reality. Speaking of the ADA’s claim that mercury combines with other metals in dental amalgam to form a biologically inactive substance, Dr. Douglas Swartzendruber, chairman and former dean of the biology department at the University of Colorado in Colorado Springs, said, “They must have discovered alchemy.”¹⁹ Existing scientific evidence strongly supports the conclusion that mercury amalgam fillings are a danger to your health.

“How could mercury be completely harmless when put into a patient’s mouth?” asks Dr. Boyd Haley, professor and chair of the department of chemistry at the University of Kentucky. “I think the situation would make a great Gilbert and Sullivan musical,” Haley notes. “It is absolute silliness

for the Environmental Protection Agency (EPA) and OSHA to say that mercury before going in and after coming out of mouth is totally toxic, but inside the mouth is absolutely safe.”²⁰

Indeed, there is no proof that the volatile substance transforms into an inert ingredient. Research shows that amalgams expose people to mercury vapors continuously, especially after fillings are stimulated by chewing, brushing or heat.

“The ADA claims that when mixed with other metals the amalgam fillings form a biologically inactive substance,” says Dr. Tano Lucero, a former research chemist and industrial hygienist for OSHA who later became president of Bio-Ethics Medical Center in Scottsdale, Arizona. “This is simply not true. Is elemental mercury escaping from filling material? The answer is an absolute YES!... Having worked for OSHA for 17 years, never have I witnessed anything of the magnitude of resistance in acknowledging the danger of toxicity in silver amalgams as by the ADA.”²¹

The Dangers of Mercury

Increasingly, the ADA’s pro-mercury position runs counter to scientific evidence proving amalgam’s dangers. As far back as 1980 the World Health Organization (WHO) identified elemental mercury vapor (the form leached by amalgam) as one of the two most hazardous types of mercury to human health. Research has shown that chronic exposure to small amounts of mercury can affect everything from the nervous and immune systems to brain and kidney functioning.

The peer-reviewed scientific literature reveals a number of disturbing facts about dental amalgam, according to a review conducted by the Australasian Society of Oral Medicine and Toxicology (ASOMAT), a nonprofit professional organization of dentists and doctors that promotes concepts of biocompatible dentistry. ASOMAT’s analysis found that the mercury contained

in dental amalgams is continuously released from fillings and almost totally absorbed, that it accumulates in tissues throughout the body, and that the very toxic metal interferes with a variety of physiological systems. Further, the physiological effects and health changes that occur can be demonstrated through the placement and removal of amalgam, and the dental profession itself has shown evidence of health problems related to mercury exposure.²²

A recent study of patients undergoing amalgam removal and chelation therapy found that the most common complaints were problems with memory and/or concentration; muscle and/or joint pain; anxiety and insomnia; stomach, bowel and bladder complaints; depression; food or chemical sensitivities; numbness or tingling; and eye symptoms, in descending order of frequency. The most distressing symptoms were headache and backache, fatigue and memory and concentration problems.²³

ASOMAT reports that controlled, broad-scale scientific studies of the health effects of mercury released from dental amalgams have never been conducted. However, amalgam fillings have been associated in the scientific literature with a number of ailments, including periodontal problems (pyorrhea), allergic reactions, oral lichen planus, immune system interference, multiple sclerosis, fatigue, cardiovascular problems, skin rashes, endocrine disorders and eye problems.²⁴

In addition, the toxic threshold for mercury vapor has never been identified, and the occupational standards that have been set are estimates based on signs and symptoms which can be clinically observed. The earliest symptoms of long-term, low-level mercury poisoning are subclinical and neurological, which makes them easy to misdiagnose.²⁵

The U.S. Public Health Service did establish a safe level of exposure to mercury

from amalgams in 1994 when it published the "Toxicological Profile for Mercury," a report by the Agency for Toxic Substances and Disease Registry. The document set a minimal risk level (MRL) for chronic and acute exposure to mercury vapor for the general population at 0.28 micrograms of mercury per day. It set an acute exposure MRL at 0.4 micrograms.

The report openly acknowledged that these levels are far below the amount of daily exposure provided by mercury amalgam fillings.²⁶ Although there is some disagreement about the amount of mercury that leaches from amalgams, one study found that a newly placed, multisurface filling in a molar can contain 750 to 1,000 milligrams of mercury and release up to 1 microgram of mercury per day.²⁷ A 1991 WHO report calculates the average daily intake of mercury from dental amalgams alone to be 3.8-21 micrograms per day.²⁸ An independent 1995 study conducted for Sweden's National Board of Occupational Safety and Health put the figure at 4-19 micrograms.²⁹ A 1998 study conducted at Sweden's prestigious Karolinska Institute estimated the intake at 5-9 micrograms per day.³⁰

Therefore, the average daily intake of mercury from amalgam fillings, as agreed upon by several international health agencies, is 10 to 50 times higher than what is considered safe by the U.S. government.

Unfortunately, a diagnosis of mercury poisoning can be difficult because the symptoms are so diverse, says Dr. Huggins. The lack of an easy and accurate diagnosis lulls the public into underestimating the dangers of mercury amalgams. "If we knew that (mercury) went to the same place every time, it would be easy to get a verdict against it," says Huggins. "But in one person (it can cause) mental problems, another person may have neurological problems and another may have problems with the heart beating fast. There are so many things that can happen, that it's very

difficult to tell what is the diagnosis of mercury toxicity.”³¹

“The disease symptoms are insidious and overlap with the symptoms of many other diseases,” points out Dr. Alfred V. Zamm, environmental medicine pioneer and author of *Why Your House May Endanger Your Health*. “Mercury poisoning is the greatest masquerader of our time. Dentists are not in a position to see the cause and effect relationship of the insertion of mercury and the development of illness three to 10 years later. Even the patient himself does not connect the illness to the original dental process.”³²

II: How Mercury Escapes into Body

Although a diagnosis itself may be elusive, the scientific research proving mercury’s toxicity has been piling up for years. The realities of mercury poisoning are hard to ignore when numerous studies show that mercury can leach from amalgams, be absorbed into tissues, travel to the brain and wreak havoc in the body. Consider the following research:

Exposure from Amalgam Fillings

The ADA has claimed that people are exposed to more mercury from fish than from dental amalgams, a statement challenged by the International Academy of Oral Medicine and Toxicology because the scientific evidence proves otherwise. As the Academy states, “Autopsies of people with fillings confirm that the amount of exposure to dietary mercury is apparently much less than that from dental amalgam mercury. Authorities in the field of metal toxicology have concluded that this chronic exposure from dental fillings makes the predominant contribution of human exposure to mercury.”³³

Numerous studies support the finding that amalgam fillings are the main source of mercury exposure in the general population. Perhaps the earliest of these is a 1991 report produced by the World Health Or-

ganization in conjunction with the United Nations Environment Programme and the International Labor Organization. This report states very explicitly that mercury dental fillings are the principal source of mercury and mercuric compound intake and retention among the general population not occupationally exposed to mercury.³⁴

A 1995 review by Drs. Lorscheider and Vimy and Anne O. Summers, a biochemist, concludes that “Medical research has demonstrated that mercury from dental amalgams is continuously released as vapor into mouth air. Animal and human experiments demonstrate that the uptake, tissue distribution, and excretion of amalgam mercury is significant, and that dental amalgam is the major contributing source to mercury body burden in humans.”³⁵

A 1994 study of patients undergoing total amalgam removal found that exposure from amalgam fillings exceeds exposure from food, air and beverages.³⁶ A 1992 experiment involving volunteers with and without amalgam fillings concluded that two-thirds of the mercury excreted in the urine of those with dental amalgams is derived originally from the mercury vapor released from their amalgams.³⁷

Leaching from Fillings

According to organized dentistry, amalgams do not pose a long-term threat because the mercury becomes inert after a filling has set for several days. But a number of studies prove that mercury continues to leach from fillings due to the ongoing deterioration of the amalgam.

Factors leading to corrosion include the physical stress of chewing, the acidity and temperature of foods and beverages and the electromagnetic potential of other metals in the mouth. Dental amalgam contains not only mercury (52% by weight), but also silver, tin, copper and zinc. Crowns and bridges may contain these elements as well as aluminum, beryllium, gold, iridium and

nickel.³⁸ Even the simple act of brushing your teeth can release mercury from amalgam, according to a 1985 report by J.E. Patterson.³⁹

In a 1983 study, Hakon Hero and other researchers at the Scandinavian Institute of Dental Materials stated that amalgam restorations tend to deteriorate at their margins after some time in service. The mechanism by which the degradation takes place is not fully understood. However, both electrochemical corrosion and particle release must be expected to occur.⁴⁰

Research shows that microgram amounts of mercury leach from fillings daily. Some researchers have found that each surface of a dental filling (an amalgam can consist of several layers) leaches 1 microgram of mercury per day.⁴¹ In vitro experiments measuring mercury leakage found that when amalgam pieces weighing 1 gram were sealed in a glass tube for less than a month, they gave off up to 30 milligrams of mercury in total. That's about 1 milligram (1,000 micrograms) of mercury per day.⁴²

In another experiment, researchers tested sterile water containing a one square centimeter piece of amalgam for two years. (One square centimeter is the size of an average dental filling.) The water was changed each day and tested for mercury content. The average daily release was 43 micrograms plus or minus 2.43

To follow through on the logic, consider that an amalgam has an initial weight of about 1 gram and that mercury comprises about half of that weight, or 500,000 micrograms. If the amalgam corrodes by 50% over its 10-year life, then half of the mercury it initially contains—or 250,000 micrograms—has vanished.⁴⁴ Many studies have shown that the mercury content of some five- to 10-year-old fillings is indeed reduced to only 25% to 35%.⁴⁵

Mercury Vapor in Expired Air

Other studies have analyzed the expired air of humans to determine how

much mercury leaches from amalgams. In a 1985 study by Drs. Vimy and Lorscheider of the University of Calgary (Canada),³⁵ subjects with amalgams chewed gum for 10 minutes and released “quite substantial” amounts of mercury vapor into intra-oral air, about six times more vapor during chewing than before. The intra-oral air of control subjects contained insignificant levels of mercury vapor, and the act of chewing did not alter those levels.

The researchers concluded: “The results demonstrate that the amount of elemental mercury released from dental amalgam exceeds or comprises a major percentage of internationally accepted threshold limit values for environmental mercury exposure. It is concluded that dental amalgam mercury makes a major contribution to total daily dosage.”⁴⁶

This study confirmed the findings of a similar experiment conducted in 1981 by C.W. Svare at the University of Iowa College of Dentistry and Environmental Chemistry. When researchers analyzed the mercury content in the expired air of 40 people with amalgams and eight without fillings, those with amalgams released 15.6 times more mercury vapor after chewing. The expired air of the other subjects remained unchanged.⁴⁷

In a study conducted in Germany in 1996, researchers found that amalgam carriers who chewed gum had urinary mercury levels twice that of controls with a similar mercury burden who didn't chew gum.⁴⁸ The more you chew, the more mercury is released.

A 1997 Russian study found that the emission of mercury vapors in the oral cavity increased with the number of fillings. According to these researchers, the concentration of mercury in the oral cavity depends primarily on the number of amalgam fillings and less so on the fillings' length of service.⁴⁹

Sam Ziff and Michael Ziff, D.D.S., cite Dr. Patrick Stortebecker on this topic: “The important point to remember is that mer-

cury vapor, ions and abraded particles are escaping and being inhaled and swallowed as well as being absorbed by the oral and nasal mucosa continuously during the lifetime of an amalgam filling.”⁵⁰

Mercury’s Route in the Body and Brain

Once an amalgam releases mercury vapor, the inhaled fumes can travel throughout the body and into the brain. The vapor is absorbed into body tissues, oxidized to ionic mercury and finally covalently bound to cell proteins.⁵¹ The mercury fumes also settle on the mucous membrane of the nasal cavity, an especially dangerous location since the mercury is then transported directly to the pituitary gland and the brain.⁵²

In fact, mercury can easily enter brain tissue after crossing the blood-brain barrier or latch on to a developing fetus after passing through the placenta. This is especially true of mercury vapor, where 74% to 100% is assimilated.⁵³

Mercury vapor has a particular affinity for the pituitary gland, according to Charles Williamson, M.D., co-director of the Toxic Studies Institute in Boca Raton, Florida. This gland is only 2 centimeters away from the oral cavity, just the other side of the cribriform plate—a light, spongy bone in the roof of the nose, between the eyes. Mercury penetrates the cribriform plate via “axonal transport.” “It goes right up the neurons,” Williamson explains.⁵⁴

Dr. Haley of the University of Kentucky adds, “I don’t want to panic people, but I think we have to be realistic. Mercury comes out of amalgams. It gets into our saliva, and we swallow it. The vapors go through the membranes of our mouth to the nasal mucosa and collect in the brain. There’s almost no way that it can’t do that. It’s not safe.”⁵⁵

The link between dental amalgams and the presence of mercury in brain tissue was established in a 1987 study conducted by Dr. David Eggleston of California in con-

junction with Dr. Magnus Nylander of Sweden. The study found a direct correlation between the number of amalgam surfaces and the amount of mercury accumulated in the brains of 83 cadavers. The subjects with five or more amalgams had an average of three times more mercury in the brain than those with no amalgams.⁵⁶

Likewise, autopsies performed at the Karolinska Institute in Sweden, whose board of governors selects the recipient of the Nobel Prize for Medicine, found that people with amalgams had three times more mercury in the brain and nine times more in the kidneys than those with no amalgams. The parts of the brain most vulnerable to mercury amalgam accumulation are the occipital lobe cortex, the cerebellar cortex and the semilunar ganglion, according to the study.⁵⁷ In a 1996 study conducted at the University of Tubingen in Germany, autopsy of 55 subjects revealed a statistically significant correlation between the number of dental amalgam fillings and the mercury concentration in the occipital lobe cortex.⁵⁸

One of the United States’ leading toxicologists, Dr. Louis Chang, also has found a direct connection between dental amalgams and mercury concentrations in the brain. “Mercury levels tend to be higher in those people that have the amalgams, and mercury levels increase as the number of amalgams increases,” reports Chang, director of interdisciplinary toxicology and experimental pathology and a professor of pathology, pharmacology and toxicology at the University of Arkansas.⁵⁹

Chang’s observation is borne out by recent research. In 1999 Croatian researchers studied two experimental groups of rats, one with amalgam fillings placed in their teeth and another fed an amalgam-supplemented diet. After a two-month exposure to mercury, brain mercury concentration in rats with amalgam fillings was eight times higher than in the controls and two times higher than in rats who ate amalgam-sup-

plemented food.⁶⁰ This study clearly elucidates the importance of the nose-brain route in mercury assimilation. The inhalation of mercury vapor from amalgam fillings delivers mercury to the brain even more effectively than eating it.

Retention of Mercury in the Body

The ADA maintains that mercury levels in the blood and urine of people with amalgams generally are not high, and therefore amalgam fillings do not cause harm. This common defense of amalgam demonstrates a lack of understanding of mercury.

The small amounts of mercury that leach from a filling stay in the bloodstream for only a short time before depositing in body tissues, according to Dr. Sandra Denton, a board member of the International Academy of Oral Medicine and Toxicology. "Instead of looking at the symptoms of mercury (poisoning), the doctors are looking for the mercury and therefore are missing the diagnosis," she says.⁶¹

Urine tests measure the amount of mercury being expelled from the body; therefore, an elevated level means a person is getting rid of mercury. It does not reflect the amount of mercury present in body tissue.

Mercury toxicity is a retention toxicity, which means that a good percentage of what goes into our bodies does not come out. Mercury never leaves the system entirely because the amalgam is continuously leaching the substance into our systems.⁶² If mercury has damaged the kidneys, this will further prevent its release into the urine.

The Effects of Methylmercury

Common organisms of the mouth and intestines can convert elemental mercury into methylmercury, an organic form of the metal that attacks the nervous and immune systems, the intestinal functioning and the allergy-triggering mechanism. Methylmercury can be particularly devastating: It is absorbed through the intestinal wall 45 times more rapidly than mer-

cury and is retained in the body longer.⁶³

Methylmercury can cause harm to every part of the body. It leads to bleeding and bone loss, a loss of muscle coordination, impaired vision and sense of smell, and kidney and glandular dysfunction. It is 100 times more toxic to the nervous system than is elemental mercury.⁶⁴ In addition, methylmercury actually penetrates a cell, while elemental mercury touches the outside of a cell and hinders its ability to interact with others. Therefore methylmercury can disrupt a cell's metabolism, break its DNA and, with the addition of a few more mercury molecules, kill the cell.⁶⁵

Methylmercury also passes the blood-brain and placental barriers. "There is virtually no barrier in the body to methylmercury," says Dr. Huggins. "It can go to every cell in the body."⁶⁶ Methylmercury can permanently damage the brain and nervous system, in fact. Following a large exposure, high levels of methylmercury can lodge in the brain for 10 years or more.⁶⁷ When methylmercury passes the placental barrier, it accumulates in the fetal brain and blood, increasing the fetus's level of red blood cells to 30% above that of the mother.⁶⁸

The Risks to Fetuses

The effect of mercury on fetal development is a troubling aspect of the use of dental amalgam. Fetal mercury exposure can cause extensive changes to the brain that affect the entire cortex (including the frontal lobe), a 26% to 55% reduction in brain weight, and a heavy loss of neurons. When the neuron loss exceeded 50%, decortication syndrome developed.⁶⁹ Pregnant women who show no signs of mercury poisoning can give birth to a child with neurological disorders caused by either mercury or methylmercury.⁷⁰

Several countries have recognized the problem of fetal exposure and acted accordingly. The Australasian Society of Oral Medicine and Toxicology reports that the health departments in Germany and Nor-

way have directed dentists not to use mercury amalgam fillings in pregnant women.⁷¹ Sweden and Canada also have advised against the use of amalgam during pregnancy, and in 1998 the British Health Ministry advised more than 50,000 doctors and dentists that amalgam fillings should not be placed or removed during pregnancy.⁷²

One look at the effect on fetuses comes from a 1989 study that followed the route of mercury vapor in the bodies of five pregnant sheep. Dr. Vimy, a consultant to the World Health Organization, placed amalgams in the sheep's molars during the middle of their pregnancy. The researchers then used a radioactive isotope to isolate the amalgam mercury from other sources and trace its course in both fetal and maternal systems.

They noted the following effects after amalgam placement:

- Day 3: Mercury buildup was evident in the maternal and fetal blood, the amniotic fluid and the maternal urine and feces.

- Day 16: Maternal mercury levels were highest in the kidneys, liver, gastro-intestinal tract and thyroid. Fetal levels peaked in the pituitary gland, liver, kidneys and placental cotyledon.

- Day 33: Most fetal tissues of the newborn sheep had higher mercury levels than did the maternal tissues, specifically in the liver, epiphysial bone, bone marrow, bile, blood and brain.

- Day 73: Mercury levels in the mothers' tissues continued to rise in the kidneys, liver, parotid glands, lungs, pancreas, gastro-intestinal tract, adrenal glands, pituitary gland, urine, bile, brain and thyroid gland.

Based on these results, the researchers concluded not only that the mercury released from fillings accumulates in maternal and fetal tissues, but also that "dental amalgam is most probably the major source of chronic mercury exposure in humans."⁷³

In 1997 parallel studies conducted on sheep and humans found that the placement and removal of "silver" tooth fillings

in pregnant and lactating humans will subject the fetus and neonate to unnecessary risk of mercury exposure. The authors concluded that mercury originating from maternal amalgam tooth fillings transfers across the placenta to the fetus, across the mammary gland into milk ingested by the newborn, and ultimately into neonatal body tissues. In lactating women with aged amalgam fillings, increased mercury excretion in breast milk and urine correlated with the number of fillings or mercury vapor concentration levels in mouth air.⁷⁴

Dr. Williamson emphasizes mercury's effect on the fetal pituitary gland, which affects the development of the endocrine, immune and reproductive systems. "The fetal pituitary gland concentrates mercury," he says. He notes that mercury decreases the transport of oxygen and essential nutrients to the fetus and depresses the enzyme isocitric dehydrogenase. This causes reduced iron uptake and hypothyroidism, learning disabilities and a reduction in IQ. Mercury exposure affects levels of nerve growth factor in the brain, impairs astrocyte function and causes brain developmental imbalances.⁷⁵

"The level of mercury in the tissue of the fetus, newborn and young children is directly proportional to the number of amalgam surfaces in the mother's mouth," Williamson says. "Inorganic mercury methylated in the mouth by microorganisms to organic mercury is the most acutely neurotoxic form."⁷⁶

Dr. Williamson believes there will be a public outcry against the use of mercury amalgam when women realize their dental fillings can damage the brains of their unborn babies and result in low IQ, learning and behavioral problems, and autism. He envisions something like the backlash against tobacco or drunken driven.⁷⁷

Children, for their part, are especially vulnerable to the effects of mercury accumulation because their bodies are still developing. In 1994 German researchers dis-

covered that children with amalgam fillings have fourfold higher urinary concentration of mercury than do children without amalgams. The researchers also confirmed the correlation between the number and extent of amalgam fillings and the urinary mercury concentration.⁷⁸

Dr. Williamson applauds the action of the American Academy of Pediatrics in calling for a moratorium on the use of Thimerosal mercury in vaccines, and those gynecologists who warn their patients not to eat fish during pregnancy. But, he points out, those measures merely scratch the surface of the problem because 87% of the body burden of mercury comes from amalgam fillings, which release mercury vapor into the body 24 hours a day.⁷⁹

As an aside, mercury toxicity also causes a variety of reproductive disorders, including sterility or reduced fertility and spontaneous abortions. Sperm count and sperm motility in males also can be significantly reduced, according to Dr. Williamson.⁸⁰

A 1992 study revealed evidence of reduced fertility among dental assistants who work with mercury. Women who prepared 30 or more amalgams per week and had three or more poor mercury hygiene factors were 50% less likely to conceive during a given menstrual cycle than unexposed women.⁸¹

III: Mercury's Litany of Health Effects

A number of studies and reports exploring the association between mercury amalgams and health disorders are presented in the pages that follow. In total, these reports offer a view of mercury's ability to enter the body and result in serious damage to physical and mental functioning.

Neurological Disorders

Occupational and environmental exposure to mercury is known to cause neurological disorders, including syndromes that mimic multiple sclerosis and amy-

otrophic lateral sclerosis, says Dr. Swartzendruber of the University of Colorado at Colorado Springs. As a result, it is reasonable to consider that the mercury from amalgam may have a similar effect.

"Much of the controversy concerning mercury is the possible relationship between mercury released from dental amalgams and multiple sclerosis," states Dr. Swartzendruber. While the controversy has not yet been addressed by a controlled clinical trial, he says, several studies provide evidence of a causal relationship. In one such study, he explains, researcher E. Baasch demonstrated in great detail that "facts concerning the geographical and age distribution, pathological development and symptomatology of multiple sclerosis are all consistent with amalgams as the primary cause of the disease."⁸²

The hypothesis that mercury from silver dental fillings may be related to multiple sclerosis was investigated in a 1994 paper by Siblingud and Keinholtz. They compared blood findings of MS subjects who had amalgams with those of MS subjects who had their amalgams removed. Those with amalgams had significantly lower levels of red blood cells, hemoglobin and hematocrit; thyroxine; and total T Lymphocytes and T-8 (CD8) suppressor cells. The MS amalgam group also had significantly higher blood urea nitrogen and lower serum IgG. Their hair mercury was significantly higher, compared with the non-MS control group. A health questionnaire found that MS subjects with amalgams had significantly more exacerbations of the MS (33.7%) during the previous 12 months than did the MS volunteers who had their amalgams removed.⁸³

A 1998 study found a "suggestive elevated risk" for MS among individuals who had a large number of amalgams for a long period of time.⁸⁴ A retrospective study conducted in England the following year found that the odds of being an MS case multiplied for every additional unit of dental fillings. This repre-

sents a 21% increase in risk of MS in relation to dental caries restorations.⁸⁵

Alzheimer's Disease

About a decade ago scientists began to document a connection between mercury and Alzheimer's disease (AD), a common neurodegenerative disorder that leads to dementia and death. A group led by Dr. William Markesbery, director of the Sanders Brown Center on Aging at the University of Kentucky, and Dr. William Ehmann autopsied the brains of Alzheimer's patients and found that their brain tissue had about double the concentration of mercury as that of patients who died of all other causes.⁸⁶ The Alzheimer's patients' nucleus basalis of Meynert, a brain area that transmits memories and sensations to higher areas of the brain, contained almost four times as much mercury as did the controls.⁸⁷

A 1995 animal study by Lorscheider, Vimy and Summers adds further credibility to the Alzheimer's-mercury connection. It revealed that mercury vapor interacts with brain tubulin and disassembles microtubules that maintain neurite structure. Thus, ionic mercury can alter a neurochemical reaction involved with maintaining neuron membrane structure. This results in the formation of "neurofibrillary tangles," which are a characteristic feature of brain tissue from Alzheimer's patients.⁸⁸

A later experiment by Lorscheider and Vimy in collaboration with Dr. Haley of the University of Kentucky's Lucille Markey Cancer Center builds on this discovery. Rats were exposed to carefully controlled dosages of mercury vapor mimicking the levels found in the mouths of people with a high number of amalgam fillings. The rats deteriorated very quickly, developing brain lesions identical to those found in human Alzheimer's disease patients.⁸⁹

On the other hand, a study conducted at the College of Dentistry at the University of Kentucky found no significant asso-

ciation between Alzheimer's disease and number, surface area or history of having dental amalgams. The researchers, led by Dr. Stanley R. Saxe, a retired professor of periodontics and geriatric dentistry, studied 68 subjects with AD and 33 control subjects without AD to determine mercury levels in multiple brain regions at autopsy and ascertain the subjects' dental amalgam status and history. The majority were assessed while they were alive; some were assessed at autopsy only. The researchers also determined three dental amalgam index scores—Event (placement, repair or removal of amalgam), Location and Time In Mouth—in addition to the numbers of and surface area of occlusal amalgam restorations. They determined mercury levels in multiple brain regions and performed full neuropathologic evaluations to confirm the normal status of the brain or the presence of AD. In addition to finding no association between Alzheimer's and amalgams, the team found no differences in brain levels of mercury between subjects with Alzheimer's disease and controls.⁹⁰

There is nothing particularly surprising about the results of this study. Studies that fail to show any positive result are common in science. It is important to understand, however, that the failure to find a positive result does not prove that there is no relationship between dental mercury and Alzheimer's disease. It merely shows that the phenomenon in question was not observable under the conditions of the experiment in question.

However, Dr. Saxe offered the following explanation of his team's results in a story distributed nationally by PR Newswire on February 5, 1999: "This study demonstrates that dental amalgam is not a major public health risk factor for Alzheimer's disease.... This is the first thorough clinical pathological correlative study of humans to show that mercury in dental amalgam restorations does not appear to be a neurotoxic factor in the development

of Alzheimer's disease."⁹¹ Saxe's statements appeared in media all over the country. However, we must ask ourselves how this study failed to find differences in brain levels of mercury between subjects with Alzheimer's disease and controls, a relationship that had been demonstrated in numerous earlier studies?⁹²⁻⁹⁷

The commentary of Sam Ziff and Michael Ziff in *Dentistry Without Mercury* reveals some of the contradictions inherent in Saxe's position.⁹⁸ They cite an earlier study in which Saxe found no correlation between mercury amalgam and indicators of AD.⁹⁹ That study, the Ziffs point out, compared a group of elderly nuns with existing amalgam molar fillings to a control group of nuns with no amalgam in their remaining molars. The problem is, the control nuns had an average of only three out of a possible 16 molars remaining (20 if you count wisdom teeth). Dr. Saxe apparently failed to consider that the molars lost by these nuns very likely did contain amalgam fillings (all the nuns had similar diet and lifestyle factors) and that the mercury levels remaining in their tissues after a lifetime of amalgam exposure would not differ from those of the nuns with existing amalgams.¹⁰⁰ In short, Saxe did not establish a valid control group. He compared two groups with similar histories of exposure to mercury from amalgam fillings and found that their status with respect to Alzheimer's disease was similar.

Saxe's more recent study had a similar flaw in methodology. Although this study compared nuns who had Alzheimer's with nuns who did not have the disease, there was no control group that had never been exposed to mercury amalgam. This is a "critical aspect of studies of this type," say the Ziffs.¹⁰¹ This missing link in the chain of discovery renders the results questionable.

Other research has since found that mercury is associated with the type of degeneration found in Alzheimer's disease. In 2000 researchers at the Neurobiology Laboratory,

Psychiatric University Hospital in Basel, Switzerland, demonstrated that neuroblastoma cells exposed to mercury show an increase in production of amyloid protein. This protein makes up the amyloid plaques that are usually found in the brain tissues when Alzheimer's patients are autopsied.¹⁰²

In addition, Dr. Lorscheider, whose University of Calgary study of mercury's effect on neurite structure is cited above, has produced direct visual evidence that clarifies the precise site and mode of action of mercury ions in causing Alzheimer's-like neurodegeneration. Lorscheider and his research team hypothesized that the growth cones from animal species could be highly susceptible to mercury ions.¹⁰³ Growth cones are the structures at the outer ends of neurites where the protein synthesis takes place. Protein synthesis is essential to cell growth and vitality. To test their hypothesis, the team cultured neurons from the central ring ganglia of a snail's brain. Following neurite outgrowth, a metal chloride solution of mercury, aluminum, lead, cadmium and manganese was applied directly onto individual growth cones. Time-lapse images with microscopy were acquired prior to, during and after the metal ion exposure. The research demonstrates that mercury ions markedly disrupted membrane structure and linear growth rates of the neurites in 77% of all nerve growth cones. When growth cones were stained with antibodies specific for both tubulin and actin, it was the tubulin/microtubule structure that disintegrated following mercury exposure. Moreover, some of the disintegrated neurites were also observed to form neurofibrillary aggregates.

In a related experiment to determine the growth-suppressive effects of mercury ions on neuronal sprouting, cells were cultured either in the presence or absence of mercury ions. The researchers found that neuronal bodies failed to sprout in the presence of mercury ions, whereas other metallic ions did not affect growth patterns of cultured snail brain cells. The authors conclude that this

visual evidence and previous biochemical data strongly implicate mercury as a potential etiological factor in neurodegeneration as observed in Alzheimer's disease.¹⁰⁴ Lorscheider's videos are quite unequivocal. You can actually see the neurites dying off as they encounter the mercury.

Depression and other Emotional Disturbances

As noted earlier, mercury can go through the roof of the mouth to within less than an inch of the posterior pituitary gland, which has much to do with our outlook on life. When these glands do not function properly, depression may result.

In a study conducted by Dr. Robert Sibley of Colorado State University in 1988, problems related to mental health were greater in patients with amalgams. Some of the common symptoms were irritability, anxiety and depression. One year after 86 of the test subjects had their amalgams removed, 70% of the recorded symptoms had either decreased or disappeared.¹⁰⁵ Mercury intoxication also has been linked to mental symptoms such as moodiness, rage and anxiety.¹⁰⁶

A more recent study by Sibley and colleagues provides further evidence that mercury amalgam fillings may be a causative factor in depression, excessive anger and anxiety. The researchers compared scores on the Beck Depression inventory for 25 women who had mercury amalgam fillings and 23 who didn't. Those with amalgams had significantly higher scores and reported more symptoms of fatigue and insomnia.¹⁰⁷

Reduced Immune Functioning

Not everyone who has dental amalgams will develop highly visible reactions that demand medical attention. But even in cases where no easily identifiable disease occurs, mercury will diminish the effectiveness of the immune system.¹⁰⁸

Mercury is considered to be a strong immune depressant because it alters the

number of T-cells. The cells decrease in number when amalgams are placed in the mouth and increase when the fillings are removed.¹⁰⁹ The other metals contained in amalgam can affect the immune system as well. One recent study of 1,000 subjects found that 90% had immune reactions to mercury, 87% to copper, 83% to zinc, 56% to tin, and 45% to silver.¹¹⁰

In his study of mercury amalgam's effect on immunomodulatory reactions, Dr. Swartzendruber of the University of Colorado found that intra-oral heavy metals altered the quantity and quality of lymphocyte subset distributions. While functional analyses were not performed on the altered lymphocytes, he states, "The consistent finding of recurrent and intercurrent infections strongly suggests that the symptomatic patients are immunocompromised." The reactive patients also experienced a serious loss of mononuclear cell viability.¹¹¹

More recently, these findings were confirmed by animal experiments conducted in Sweden. In a 1994 study, 8-100 mg of silver amalgam or silver alloy was implanted in the peritoneal cavity of mice for 10 weeks or six months. The researchers found an unsettling litany of immune effects.¹¹²

Dental amalgam in genetically sensitive mice causes a chronic stimulation of the immune system with the induction of systemic autoimmunity. The authors conclude that under appropriate conditions of genetic susceptibility and adequate body burden, heavy metal exposure from dental amalgam may contribute to human immunological aberrations, which could lead to overt autoimmunity. This research is strongly suggestive of a link between mercury amalgam and autoimmune disorders.¹¹³

Given these results, reports Dr. Swartzendruber, amalgam's impact on immunity should be carefully studied. "It is possible that such individuals may also be susceptible to other systemic effects of

heavy metal, particularly since in the rat it is clear that heavy metals can induce autoimmune disorders. Heavy metals should be carefully considered as possible etiological agents in human diseases thought to have an autoimmune component.”¹¹⁴

Antibiotic Resistance

When bacteria resist certain antibiotic drugs or classes of drugs, doctors may have to use higher doses, which drives up the cost of treatment. Worse still, some antibiotics lose their effectiveness altogether, and doctors have a narrower choice of drugs to choose from in treating illness. As such, antibiotic resistance is a serious public health issue.

What does this resistance have to do with mercury amalgam? That is a question no one asked until 1989, when microbiologist Anne Summers came upon the pioneering work of Drs. Lorscheider and Vimy showing that amalgam fillings in sheep's molars released toxic mercury that could be tracked all over the animals' bodies.¹¹⁵ In her studies of antibiotic resistance, Summers had long been aware that human fecal bacteria had a high degree of resistance to the toxic effects of mercury. But this finding had puzzled her. How had all these people been exposed to mercury?¹¹⁶ Based on the work of Lorscheider and Vimy, Summers began to suspect that the cause of the mercury-resistant fecal bacteria was the mercury in people's mouths.

Soon after, Summers teamed up with Lorscheider and Vimy at the University of Calgary to study the relationship among mercury amalgam, mercury resistance and antibiotic resistance. Their groundbreaking 1993 study demonstrated that mercury released from amalgam fillings implanted in monkeys' teeth caused a significant increase in resistance to mercury along with an alarming increase in antibiotic resistance in the oral and intestinal bacteria of primates.¹¹⁷ The study also documents the results of Summers's earlier research on

human fecal bacteria showing that those with a high prevalence of mercury-resistant intestinal bacteria were significantly more likely to have a resistance to two or more antibiotics.

Scientists have known for some time that the genes which enable bacteria to resist the toxic effect of mercury are carried in the same DNA structures that carry the genes for antibiotic resistance. Summers and her colleagues have advanced scientific knowledge one step further. They have shown that once a bacterium is exposed to mercury and becomes mercury resistant, it is primed to become antibiotic resistant as well.¹¹⁸ This is yet another instance in which mercury amalgam fillings threaten our health and well-being.

Impaired Kidney Functioning

The impairment of kidney functioning from mercury amalgam may be even more severe than previously thought, according to another study by Drs. Vimy, Lorscheider and others. Again, the researchers placed amalgams in the teeth of sheep (whose weight and chewing mechanism compare well with those of humans). Within 30 days, the sheep lost half of their kidney function, and beyond that point the functioning remained low.¹¹⁹

Blood and Bone Cell Sensitivity

Preliminary studies at Colorado University indicated that blood and bone cells may be highly sensitive to mercury. Researchers found that mercury in a ratio of less than 40 parts per billion was lethal to white blood cells. Another study found that mercury concentrations of less than 0.4 parts per million killed bone cells. Yet it is estimated that at least 700 times more mercury than this amount rests in the gum tissue next to amalgam fillings.¹²⁰

A laboratory study published in 2000 by the Biomaterials Unit of the School of Dentistry at the University of Birmingham in England gives further support to those findings. Mercury released from Tytin, a

mercury amalgam dental filling material, undermined the viability of bone-building osteoblast cells in culture. The cells were grown from the bones of 2- to 3-day-old Albino Wistar rats and were exposed to the test materials for 1 or 6 days. The number of viable cells in each test group was determined, and the area of cell death around the test specimens also was measured. Mercury was the main element released from the dental amalgam, followed by copper and silver. The viability of cultures containing Tytin was significantly lower than that of cultures with a gallium-based alloy and the controls.¹²¹

A study of cytotoxicological effects on animal tissues concluded that the level of mercury and copper in amalgam filling materials makes them significantly more cytotoxic than either of two amalgam alternatives.¹²²

Effects on Dentists and Dental Personnel

The American Dental Association's position on amalgam-related illness is ironic, given the effect amalgam has on those who work with it every day: dentists and their staff. As early as 1987 a Swedish study conducted for the Occupational Health Program of the Harvard School of Public Health assessed whether suicide rates were higher among dentists than other college-educated professionals over the 10-year course of the study. The study found that male dentists had an elevated standardized mortality ratio compared with other male academics. The authors concluded that the mental health consequences of mercury exposure among dentists should be investigated further.¹²³

Related studies indicate that dentists may be more vulnerable to stress and consequent depression than members of other professions.¹²⁴ For example, a study of dentists in private practice in South Africa found that 10 percent had suicidal ideation.¹²⁵

A 1995 study documented the behavioral effects of low-level mercury ex-

posure on dentists working with amalgam. Behavioral tests revealed significant defects, including poor mental concentration, emotional lability and mood problems in the mercury-exposed dentists compared with a control group of non-amalgam dentists.¹²⁶

A follow-up cross-study found that long-term exposure to amalgam can make dentists' hands unsteady, which affects their manual dexterity. Researchers found remarkable differences in psychomotor performance between the amalgam and non-amalgam dentists. The most significant associations were found for the Intentional Hand Steadiness Test. The authors warn that the IHST results should be carefully considered by dental professionals who rely on manual dexterity in restorative dentistry.¹²⁷ That would include any dentist who does fillings, root canals or bridgework.

In a later study, the authors compared the degree of mercury in dentists' tissues with measures of mercury toxicity, including fine manual speed, accuracy and coordination, that are of particular relevance for dental professionals who work with handheld tools. The study found subtle preclinical effects at very low levels of mercury exposure (less than 4 micrograms per liter of urine), with far more severe clinical deficits at higher mercury levels. Behavioral responses typically increased with exposure in a fairly uniform manner, indicating a more general response. These studies present new evidence that adverse behavioral effects may occur even with what is classified as low exposure.¹²⁸

Environmental Impact

Looking at the use of dental amalgam from an environmental point of view provides another chilling perspective on this issue. Wastewater from dental offices is a significant source of environmental mercury pollution. A study of Danish dental clinics found that clinics with mercury separators released a mean value of 35 mg mercury per day. Clinics without separators

released a mean value of 270 mg per day. Thus, several hundred grams of mercury per clinic may be discharged annually with the wastewater. The authors concluded that the use of efficient amalgam separators may reduce the mercury outlet markedly.¹²⁹

Very few dental offices in the United States have amalgam separators, however. If one of these offices releases the mean value of 270 milligrams a day over 200 working days, it would discharge 54 grams of mercury per year. Using a conservative estimate of 100,000 dental offices in the United States, we can estimate that a total of 5,400 kilograms (12,172 pounds) of mercury exits these offices in wastewater each year.¹³⁰

One source reports that the total discharge into sewers from individual homes and businesses is even more than at dental offices, since the average person with amalgam fillings excretes approximately 100 micrograms of mercury per day in body waste.¹³¹ This has been confirmed by medical labs such as Biospectron in Sweden that do thousands of stool tests per year, and is consistent with studies measuring levels in residential sewers by municipalities.¹³² In the U.S. this would amount to approximately 7,300 kilograms—or more than 8 tons—being released into sewers per year.

The U.S. Environmental Protection Agency, for its part, has defined mercury amalgam as a hazardous substance. On behalf of the EPA, the U.S. Justice Department brought a lawsuit in 1988 against a group of New England dentists and dental companies for damages caused by the faulty disposal of scrap amalgam. All parties involved eventually signed consent decrees requiring them to reimburse the EPA a total of roughly \$350,000 for cleanup costs.¹³³

According to a 1989 issue of the ADA News, when the EPA was asked whether it considered dental amalgam to be a hazardous substance, it replied that “any substance that contains a listed hazardous substance is itself a hazardous substance,”

provided there is “a release, or threatened release, of a hazardous substance into the environment and where the government has incurred response costs.” In addition, the EPA sent a letter to one of the dental supply firms in 1988 that specifically refers to amalgam as a hazardous substance: “The term ‘hazardous substance’ shall have the same definition as that contained in Section 101(14) of CERCLA and includes scrap or waste dental amalgam and any mixture of such hazardous substances with any other substances.”¹³⁴

Part 4: Politics of a Toxin's Use

How great is the danger from mercury amalgam? This question stirs hot debate between those who question its use and those who promote it as a safe and effective compound.

By conservative estimates, the average adult American has 10 fillings of three surfaces apiece. If each surface leaches 1 microgram of mercury per day, then the average adult faces potential exposure to 30 micrograms of mercury a day from amalgams alone.¹³⁵ Even if the figure is lower, at only 1 microgram per filling, the potential exposure would be 10 micrograms per day.

The Toxic Element Research Foundation estimates that people with 13 or more amalgams exceed the World Health Organization's daily mercury limit of 42.9 micrograms—even before accounting for their exposure to mercury from other possible sources such as food and air.¹³⁶ The U.S. Food and Drug Administration cautions against any increase in the daily mercury exposure rate from food of 2.89 micrograms.¹³⁷

The ADA claims that amalgam is unsafe only for the 1% of Americans it estimates to be hypersensitive to mercury. The results of other research, however, call that estimate into question. Studies cited by the Journal of the Massachusetts Dental Society indicate that the level of hypersensitivity is 10 times higher. One study of 1,538

people found 9.6% to be hypersensitive; another study of 1,000 subjects put the number at 11.3%.¹³⁸ The Ziffs cite two studies showing that the prevalence of allergy to amalgam can be as high as 44.3%.^{139,140} One of the studies tested a population of dental students. Yet these studies are not presented in ADA publications and public statements.

The ADA cites the widespread use of amalgam over the past 150 years as evidence of its safety. The organization suggests that “the most convincing support we have for the safety of dental amalgam is the fact that each year more than 100 million amalgam fillings are placed in the U.S.” This rationale offers little comfort to those who question amalgam’s use. “This is a chilling thought,” states the International Academy of Oral Medicine and Toxicology. “It should be a cause for concern that approximately 72 million tons of mercury are used annually in dentistry, much of it being placed into the teeth of Americans.”¹⁴¹

The ADA also states that “studies have failed to find any link between amalgam restorations and any medical disorder. Amalgam continues to be a safe restorative material for dental patients.”¹⁴² In 1984 the ADA did alter its position slightly to admit that mercury escapes from amalgam. But it still maintained that the amounts in question were too small to cause any damage to the body.¹⁴³

The ADA no longer maintains that amalgam’s safety has been scientifically proven, according to the Academy. Nor does it offer certification of the safe and effective use of mixed amalgam. It says amalgam cannot be certified because it is mixed by individual dentists who must take responsibility for the material’s safety.^{144, 145}

The ADA filed legal briefs in which it abdicated any responsibility for the damage done by mercury amalgams in *Tolhurst v. Johnson & Johnson*, a California lawsuit in which a dental patient sued his dentist, two amalgam manufacturers, a distributor and

the ADA itself. The brief stated: “The ADA owes no legal duty of care to protect the public from allegedly dangerous products used by dentists. The ADA did not manufacture, design, supply, or install the mercury-containing amalgams. The ADA does not control those who do. The ADA’s only alleged involvement was to provide information regarding its use. Dissemination of information relating to the practice of dentistry does not create a duty of care to protect the public from potential injury.”¹⁴⁶

The court agreed that the ADA bore no responsibility for the use of amalgam and dismissed it from the case.¹⁴⁷ Apparently we are expected to ignore the fact that the ADA holds the patents on the high-copper amalgam currently in use by most dentists, is responsible for certifying all dental schools in the United States, and certainly does not encourage cutting-edge dentists who use any product or procedure other than what they were taught in dental school.

Meanwhile, how has the U.S. government responded to the debate over dental amalgam? While the EPA has defined mercury amalgam as a hazardous substance, the FDA has skirted the issue of amalgam safety over the years. When 1976 legislation required the FDA to classify all medical and dental devices, the agency “grandfathered” its approval of the long-used amalgam fillings under the GRAS (generally recognized as safe) category, according to Joyal W. Taylor, D.D.S., who founded the Environmental Dental Association to spearhead a movement for informed consent legislation concerning amalgam’s use.¹⁴⁸

One decade later, in 1987, the FDA’s Classification of Dental Devices was published in the Federal Registry. Dental amalgam, it turned out, was not even listed as a dental device, based on the rationale that amalgam is a reaction product. Instead, the FDA classified the components of amalgam, which means that amalgam itself has never been approved as a dental device, according

to the Environmental Dental Association. Therefore, it has not undergone the "rigorous biocompatibility testing required of all other medical implant devices."¹⁴⁹

In early 1991 the FDA clarified its position on mercury amalgam. After "reviewing" the subject, the agency announced that the use of amalgam could not be condemned based on current evidence. It recommended that more studies on the subject be conducted. At the same time, the FDA's Dental Products Panel of the Medical Devices Advisory Committee held a public meeting and, again, declared that the evidence against dental amalgam was not sufficient to prove its harm. This panel also said that amalgam should be researched further.¹⁵⁰

The National Institutes of Health has taken the same stance on the amalgam issue. The NIH's mid-1991 conference on the "Effects and Side Effects of Dental Restorative Material" concluded: "There is no scientific evidence that currently used restorative materials cause significant side effects. Available data do not justify discontinuing the use of any currently available dental restorative materials or recommending their replacement." Interestingly, however, the NIH did recommend that dentists could "reduce environmental contamination" by installing devices in their offices to recover waste amalgam residue for recycling.¹⁵¹

The Battle Rages on

The ADA opposes any legislation that seeks to inform patients of the contents of dental amalgam, a position that appears to contradict its argument that amalgam does not cause harm. Recent developments at the state and federal levels offer a ray of hope regarding consumer education and choice in this area, however.

In November 2001 Congresswoman Diane Watson (D-Los Angeles) introduced the first federal bill to address the use of mercury in dental amalgams. This legislation would warn consumers about the risks posed by mercury fillings and eliminate the

use of the toxic metal in dentistry over a five-year period.¹⁵² Congresswoman Watson stated: "The fillings that most of us know as 'silver' are mainly composed of mercury, not silver. Mercury is an acute neuro-toxin. It is the most toxic non-radioactive element and the most volatile heavy metal. It's time to remove mercury from the practice of dentistry."¹⁵³

The introduction of this bill was applauded by Charles G. Brown, lead attorney in the effort to end mercury's use in dentistry and the former state attorney general in West Virginia. He pointed out that mercury either has been or is being eliminated from products such as thermometers, vaccines and disinfectants. "It is politically and medically untenable to be removing mercury from all other medical uses and at the same time continuing to place it in people's mouths," Brown said.¹⁵⁴

At the state level, California became the first state to require dentists to inform their patients of the possibility of birth defects caused by mercury amalgams. Since November 2000, the following sign has been posted in dental offices in California: "WARNING: Amalgam fillings contain a chemical element known to the State of California to cause birth defects or other reproductive harm." (Notice, however, that the chemical is not named. The reason is that the California Dental Association, the state chapter of the ADA, doesn't want it to be.)

The origins of this warning can be traced to 1986, when California passed the Safe Drinking Water and Toxic Enforcement Act (Proposition 65), Health and Safety Code #25249.5. The act was designed to protect pregnant women and their unborn babies from toxic chemicals, and it specified that no person or company could expose a person to any substance known to cause birth defects without warning him or her first.

The act lists mercury as one of these substances, but its requirements were not honored by amalgam manufacturers. When

pressed to do so in 1996, they asserted that they were exempt because the FDA's regulation of their product supercedes the requirements of Proposition 65. The courts didn't buy that argument, but still the manufacturers did nothing.

Then Oakland's Environmental Law Foundation and a Washington, D.C., organization called Consumers for Dental Choice brought suit against the state's dental amalgam manufacturers and distributors, demanding they meet their obligations under Proposition 65 by placing warning labels on their products and in the offices of dentists who use them. Such labels are already in use in many countries, including all those of the European Union.¹⁵⁵

After three years of legal process, on November 15, 2000 a judge of the Superior Court of California in San Francisco issued a consent decree requiring California amalgam manufacturers to disclose to their customers the potential for birth defects and reactions to other toxic dental materials.¹⁵⁶ This was a small but significant step in the effort to inform consumers about the dangers of mercury amalgam.

Another step toward disclosure was taken in June 2001, when Charles Brown and Shawn Khorrami, a public interest attorney, filed a lawsuit against the ADA and its California affiliate charging them with deceiving people into thinking dental amalgams are made of silver when a major component of the fillings is in fact mercury. The lawsuit was filed on behalf of organizations and individuals that want to eliminate mercury's use in amalgam fillings. The groups include Kids Against Pollution, the American Academy of Biological Dentistry, and Dental Amalgam Mercury Syndrome Inc.¹⁵⁷

The attorneys also served the legally required notice that they would sue the ADA under the provisions of California's Proposition 65. Khorrami stated: "...Our complaint is not with individual dentists, many of whom share our concern about the use of mercury, but with the ADA, which

has a vested economic interest in the continued use of mercury and which has exercised undue and unfair pressure on dentists not to warn their patients of the dangers of mercury."¹⁵⁸

The state of Colorado also has increased consumer choice in this area. In 1997 Governor Roy Romer signed into law a bill to enhance access to mercury-free dentistry for the people of that state. House Bill 97-1187 was introduced by Rep. Mark Paschall with the support of Sen. Muntzebaugh to support consumers' rights to choose safe, effective alternatives to conventional dental procedures.¹⁵⁹

This dental freedom law is the first of its kind to be passed in the United States. It enables patients to choose mercury-free dentistry through dentists licensed in Colorado. It further assures that trained and licensed dentists can continue to practice mercury-free dentistry without fear of retribution from the Colorado Board of Dental Examiners.¹⁶⁰

The Trickle-down Effect

The ADA's position on mercury carries considerable weight. Since state dental boards tend to operate in general agreement with the ADA, its philosophy trickles down to the local level. Dentists who place alternative fillings tend to be looked at more carefully, although this varies from state to state. Dentists who malign mercury as hazardous are threatened with expulsion from the ADA in four states.¹⁶¹ And the dental leadership in several states threatens to censure dentists who inform patients that amalgam contains mercury.¹⁶²

According to the ADA's Code of Ethics, any dentist who removes a serviceable amalgam filling from a nonallergic patient for the purpose of removing toxic substances (such as mercury) from the body is acting unethically. The ADA's edict specifies that the treatment is improper when it is "performed solely at the recommendation or suggestion of the dentist."¹⁶³

In an accompanying statement, the ADA said, "There is no scientifically documented evidence of a cure or improvement of a specific disease or malady due to removal of amalgam restorations from a nonallergic patient." While some dentists may have a "good faith disagreement with the established scientific position on the issue," said the statement, that belief does not justify the removal of amalgam given the lack of credible evidence.¹⁶⁴

Despite the ADA's position, many dental practitioners advocate the removal of amalgam and replacement of the filling with alternative materials.¹⁶⁵ A 1998 study of 12 patients undergoing amalgam removal at the Karolinska Institute found that 60 days after removal, mercury levels in blood, plasma and urine had declined to 60% of pre-removal levels. Over time, mercury levels approached those of subjects without any history of amalgam fillings.¹⁶⁶

A Swedish survey of 60 patients who had dental amalgams replaced found that 78% were either satisfied or very satisfied with the results, while 9.5% were disappointed.¹⁶⁷ As noted earlier, some of the most common complaints were memory and/or concentration problems; muscle and/or joint pain; anxiety and insomnia; stomach, bowel, and bladder complaints; and depression. Headache and backache responded best to treatment, but all symptoms showed considerable improvement on average.¹⁶⁸

One disorder that may improve following amalgam removal is a deficiency of white blood cells. A blood test showed that the number of T-lymphocytes increased in three patients after their amalgams were removed, according to a 1984 report by Dr. David Eggleston in the *Journal of Prosthetic Dentistry*. These cells, which combat invaders such as viruses, bacteria and parasites, decreased again when the amalgams were put back in the patients' mouths.¹⁶⁹

Political Power Plays

The United States is not the only country in which mainstream dental or medical organizations have downplayed information on the dangers of mercury amalgam. Similar situations have occurred in other countries as well.

In the opinion of Dr. Sam Ziff, a political power play is at work with the issue of legal liability lurking in the background. He offers the example of Sweden, where a special commission declared amalgam to be an unsuitable dental filling. The medical and dental establishment applied political pressure until the commission publicly recanted its statement. But when scientists took the commission to task on national television, the Swedish Social Welfare and Health Administration made an historic about-face and supported the original statement against the use of amalgam. As this case illustrates, says Ziff, "There is a lot of political pressure being brought to bear. They've been using it for 150 years, and nobody likes to admit they've been wrong for that long."¹⁷⁰

The Swedish agency did just that, however, when it declared amalgam to be "an unsuitable and toxic dental filling material which shall be discontinued as soon as suitable replacement materials are produced," according to a Swedish newspaper. An official said: "We now realize that we have made a mistake. This has caused people to suffer unnecessarily."¹⁷¹ In 1998 the Swedish government decided to stop reimbursements by the social security service of the use of amalgams as fillings effective in 1999, with a total ban imposed as of 2001.¹⁷²

In Germany, the Department of Health prohibited the sale of "conventional" (gamma-2) amalgam in 1992. (The agency maintained that non-gamma-2 amalgams are safer than the banned variety, a position the Environmental Dental Association questions.) Much like the ADA, the German Dental Association had claimed all along that mercury cannot escape from amalgams—a position in direct contrast to the scientific evidence on the sub-

ject. In 1997 a consensus was reached in Germany for a case-by-case approach leading to an official contraindication of the use of amalgams in children of less than six years of age, pregnant or breastfeeding women and patients with kidney problems.¹⁷³

Another country that has considered the amalgam issue is Australia. The government's primary medical watchdog, the National Health and Medical Research Council (NHMRC), has found mercury amalgam to be safe and effective even though it was presented with data on the dangers of amalgam from the Australasian Society of Oral Medicine and Toxicology. ASOMAT submitted a report to the NHMRC in 1998 that documented research on mercury and recommended that the use of amalgam be phased out over three to five years.

The report, authored by Dr. Roman Lohyn and Dr. Robert Gammal, also recommended that amalgams not be used in the following people or circumstances: pregnant women, breastfeeding women, children under the age of 6, people with kidney problems, people with neurological problems, in retrograde root-canal fillings, as cores underneath metal-based crowns, in conjunction with other metals in the mouth, in people with diagnosed lichen planus, and in people with a compromised immune system.¹⁷⁴

A Working Party formed by the NHMRC to study the issue found mercury amalgam to be safe and effective. However, the group also advised that it would be prudent to use alternatives to amalgam for children, pregnant women and people with kidney disease. A risk assessment was then completed in 2001, and this assessment also found that amalgam was safe and effective.^{175, 176}

A Challenge To The ADA

The International Academy of Oral Medicine and Toxicology issued this response in mid-1990 to the ADA's then-recent statement of confidence in amalgam: "Given the inconsistencies between the scientific facts and the American Dental Association

Special Report, the (Academy) has serious concerns regarding the ADA's lack of scientific rigor and the tendency to misinform the dental profession and, thereby, the public at large regarding the established scientific facts about amalgam safety."

"We hereby call to task the ADA for failure to adequately support their position on dental amalgam with hard scientific data. This failure has resulted in inadequate protection to the public and inadequately protects the membership of the ADA from personal harm due to amalgam usage."¹⁷⁷

Likewise, researchers at the University of Calgary reached this conclusion following their 1989 study of amalgam: "Our findings are at variance with the anecdotal opinion of the dental profession, which claims that amalgam fillings are safe. Experimental evidence in support of amalgam safety is at best tenuous. From our results, we conclude that dental amalgam can be a major source of chronic mercury exposure."¹⁷⁸

Today the burden of proof regarding the safety of amalgam lies with those who defend its use, according to Victor Penzer, M.D. Its advocates must offer convincing support of their position, given the many studies that show a substantial danger in using mercury amalgams. "Only valid scientific evidence of safety could possibly justify the continuation of amalgam use in dental practice," he states.¹⁷⁹ In fact, toxicity experts such as Thomas Clarkson of the University of Rochester Medical School and Lars Friberg of the Karolinska Institute argue against the notion of a "safe" level of mercury exposure.¹⁸⁰

In the future, frontier societies such as the United States must rise above their history of exploiting natural resources without regard for the long-term consequences. Much like the strip mine, the use of harmful pesticides and deforestation, mercury amalgam is a legacy to a pay-later society. But the days of indiscriminate use of resources are long gone, and we must now establish a new ethic in tune with our new reality.

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References

1. *Report of ICBM (International Conference on the Biocompatibility of Materials)*, 1988; 44.
2. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
3. Eggleston DW, Nylander M: Correlation of dental amalgam with mercury in brain tissue. *J Prosthet Dent*, 1987 Dec; 58(6): 704-7.
4. Huggins H, DDS, MS: "*Medical and Legal Implications of Components in Dental Materials*," 4.
5. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
6. Stortebecker P MD, PhD: Direct transport of mercury from the oro-nasal cavity to the cranial cavity as a cause of dental amalgam poisoning. *Swed J Biol Med*, 1980 Mar: 19.
7. Huggins Diagnostic Center, *The PAR Booklet (Proper Amalgam Removal)*. Sept 1989; 12.
8. The Harvard Medical School, *Harvard Health Lett*, Sept 1990.
9. Saving Your Teeth, *Natural Living Newsletter*, No. 11.
10. Huggins H, DDS, MS: "*Mercury in My Molars*." 1989; 4.
11. Two studies suggest risk from silver fillings. *Chicago Tribune*, Aug 15, 1990.
12. *Silver (Mercury Amalgam) Dental Fillings*, Natural Living Newsletter, No. 32.
13. (*Historical archive*). Regulation of mercury and the politics of amalgam fillings.
14. Dodes JE: The amalgam controversy. An evidence-based analysis. *J Am Dent Assoc*, 2001 Mar; 132(3): 348-56.
15. *ADA News*, Jan 2, 1984.
16. Huggins H, DDS: "Integrity vs. Intimidation," 11.
17. *Ibid*.
18. *Ibid*.
19. Malt UF, Nerdrum P, Oppedal B, et al: Physical and mental problems attributed to dental amalgam fillings: a descriptive study of 99 self-referred patients compared with 272 controls. *Psychosom Med*, 1997 Jan-Feb; 59(1): 32-41.
20. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
21. *Ibid*
22. Lohyn R, Gammal R: ASOMAT Australasian

- Society of Oral Medicine and Toxicology submission to amalgam review working party of Australia's National Health and Medical Research Council, Part B. May 1988; 50.
23. Kidd RF: Results of dental amalgam removal and mercury detoxification using DMP5 and neural therapy. *Altern Ther Health Med*, 2000 Jul; 6(4): 49-55.
 24. Lohyn R, Gammal R: Highlights of ASOMAT's 2 part submission. *Amalgam Review Working Party of Australia's National Health and Medical Research Council*, Part A. June 15-16, 1998; 6.
 25. Lohyn, *Part A*, 6-8.
 26. Weiner JA, Nylander M: An estimation of the uptake of mercury from amalgam fillings based on urinary excretion of mercury in Swedish subjects. *Sci Total Environ*, 1995 Jun 30; 168(3): 255-65.
 27. Hahn LJ, Kloiber R, Vimy MJ, et al: Dental "silver" tooth fillings: a source of mercury exposure revealed by whole-body image scan and tissue analysis. *FASEBJ*, 1989 Dec; 3(14): 2641-6.
 28. Ziff S, Ziff MF, DDS: *Dentistry Without Mercury*. Orlando, FL. Bio-Probe Inc.; 11.
 29. *Weiner and Nylander*.
 30. *Ibid*.
 31. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
 32. Ziff and Ziff.
 33. Friberg L, Kullman L, Lind B, et al: Mercury in the central nervous system in relation to dental amalgam. *Lakartidningen*, 1986 Feb 12; 83(7): 519-22.
 34. World Health Organization: *Environmental Health Criteria Series*, 1991.
 35. Lorscheider FL, Vimy MJ, Summers AO. Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm. *FASEBJ*, 1995 Apr; 9(7): 504-8.
 36. Begerow J, Zander D, Freier I, et al: Long-term mercury excretion in urine after removal of amalgam fillings. *Int Arch Occup Environ Health*, 1994; 66(3): 209-12.
 37. Aposhian HV, Bruce DC, Alter W, et al: Urinary mercury after administration of 2,3-dimercaptopropane-1-sulfonic acid: correlation with dental amalgam score. *FASEBJ*, 1992 Apr; 6(7): 2472-6.
 38. Huggins, *Medical and Legal*, 1-2, 19.
 39. Patterson JE, et al: Mercury in human breath from dental amalgam. *Bull Environ Contam Toxicol*, 1985 Apr; 34(4): 459-68.
 40. *Stortebecker*.
 41. Huggins, *Medical and Legal Implications*, 3.
 42. *Stortebecker*.
 43. Sibley RL, Motl J, Kienholz E: Psychometric evidence that mercury from silver dental fillings may be an etiological factor in depression, anger, and anxiety. *Psychol Rep*, 1994 Feb; 74(1): 67-80.
 44. *Stortebecker*.
 45. Silver, *Natural Living Newsletter*, No. 32.
 46. Vimy MJ, Lorscheider FL: Serial measurements of intra-oral air mercury: estimation of daily dose from dental amalgam. *J Dent Res*, 1985 Aug; 64(8): 1072-5.
 47. Svare CW, Peterson LC, Reinhardt JW, et al: The effect of dental amalgams on mercury levels in expired air. *J Dent Res*, 1981; 60: 1668-71.
 48. Gebel T, Dunkelberg H: Influence of chewing gum consumption and dental contact of amalgam fillings to different metal restorations on urine mercury content. *Zentralbl Hyg Umweltmed*, 1996 Nov; 199(1): 69-75.
 49. Motorkina AV, Barer GM, Volozhin AI: Patterns of mercury release from amalgam fillings into the oral cavity. *Stomatologiya (Mosk)*, 1997; 76(4): 9-11.
 50. Ziff and Ziff, *Dentistry Without Mercury*, p. 17, citing Stortebecker P: Mercury poisoning from dental amalgam — a hazard to human brain. 1985; 32-43.
 51. Lorscheider FL, Vimy MJ, Summers AO: Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm.
 52. *Stortebecker*.
 53. *Svare*.
 54. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
 55. *Ibid*
 56. *Eggleston and Nylander*.
 57. Nylander M, Friberg L, Lind B: Mercury concentrations in the human brain and kidneys in relation to exposure from dental amalgam fillings. *Swed Dent J*, 1987; 11(5): 179-87.
 58. Maas C, Bruck W, Haffner HT, et al: Study on the significance of mercury accumulation in the brain from dental amalgam fillings through direct mouth-nose-brain transport (article in German). *Zentralbl Hyg Umweltmed*, 1996 Feb; 198(3): 275-91.
 59. *Report of ICBM conference*, 3.
 60. Galic N, Prpic-Mehicic G, Prester L, et al: Dental amalgam mercury exposure in rats. *Biometals*, 1999 Sept; 12(3): 227-31.

61. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
62. *Svare*.
63. Peaker M, Linzell JL: Biosynthesis and degradation of methylmercury in human feces. *Nature*, 1975 Feb 6; 462-4.
64. Eyl T: Methyl mercury poisoning in fish and human beings. *Modern Medicine*, 1970 Nov 16; 135-41.
65. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
66. *Ibid*.
67. Silver, *Natural Living Newsletter*; No. 32.
68. *Eyl*.
69. Inskip MJ, Piotrowski JK. Review of the health effects of methylmercury. *J Applied Toxicol*, 1985 June; 5(3): 113-33.
70. Marsh DO, et al. Fetal methylmercury poisoning, clinical and toxilgical data on 29 cases. *Ann Neurol*, 1980 Apr; 7(4): 348-53.
71. *Lohyn, Part B, 50*.
72. *Lohyn, Part A, 4, 11*.
73. Vimy MJ: Abstract of vital new mercury amalgam research, 1989.
74. Vimy MJ: Hooper DE, King WW, Lorscheider FL: Mercury from maternal "silver" tooth fillings in sheep and human breast milk. A source of neonatal exposure. *Biol Trace Elem Res*, 1997; 56(2): 143-52.
75. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
76. *Ibid*.
77. *Ibid*.
78. Schulte A, Stroll R, Wittich M, et al: Mercury concentrations in the urine of children with and without amalgam fillings. *Schweiz Monatsschr Zahnmed*, 1994; 104(11): 1336-40.
79. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
80. *Ibid*.
81. Quicksilver Associates: *The mercury in your mouth: the truth about "silver" dental fillings*. New York. Quicksilver Press. 1998; 69-70.
82. *Maas*.
83. Sibley RL, Kienholz E: Evidence that mercury from silver dental fillings may be an etiological factor in multiple sclerosis. *Sci Total Environ*, 1994 March 15; 142(3): 191-205.
84. Bangsi D, Ghadirian P, Ducic S, et al: Dental amalgam and multiple sclerosis: a case-control study in Montreal, Canada. *Int J Epidemiol*, 1998 Aug; 27(4): 667-71.
85. McGrother CW, Dugmore C, Phillips MJ, et al: Multiple sclerosis, dental caries and fillings: a case-control study. *Br Dent J*, 1999 Sep 11; 187(5): 261-4.
86. Wenstrup D, Ehmann WD, Markesbery WR: Trace element imbalances in isolated subcellular fractions of Alzheimer's disease brains. *Brain Res*, 1990 Nov; 533: 125-30. Cited in Quicksilver Associates: *The mercury in your mouth*, 53-4.
87. Thompson C, Markesbery W, Ehmann W, et al: Regional brain trace element studies in Alzheimer's disease. *Neurotoxicology*, 1988 Spring; 9(1): 1-7. Cited in Quicksilver Associates: *The mercury in your mouth*, 54.
88. Lorscheider FL, Vimy MJ, Summers AO, et al: The dental amalgam mercury controversy— inorganic mercury and the CNS; genetic linkage of mercury and antibiotic resistances in intestinal bacteria. *Toxicology*, 1995 Mar 31; 97(1-3): 19-22.
89. Pendergrass JC, Haley BE, Vimy MJ, et al: Mercury vapor inhalation inhibits binding of GTP to tubulin in rat brain: similarity to a molecular lesion in Alzheimer diseased brain. *Neurotoxicology*, 1997; 18(2): 315-24.
90. Saxe SR, Wekstein MW, Kryscio RJ, et al: Alzheimer's disease, dental amalgam and mercury. *J Am Dent Assoc*, 1999 Feb; 130(2): 191-9.
91. *PR Newswire*, New York, Feb 5, 1999.
92. DE, Ehmann WD, Markesbery WR: Trace element imbalances in hair and nails of Alzheimer's disease patients. *Neurotoxicology*, 1988 Summer; 9(2): 197-208.
93. Wenstrup D, Ehmann WD, Markesbery WR: Trace element imbalances in isolated subcellular fractions of Alzheimer's disease brains. *Brain Res*, 1990 Nov 12; 533(1): 125-31.
94. Ehmann WD, Markesbery WR, Alauddin M, et al: Brain trace elements in Alzheimer's disease. *Neurotoxicology*, 1986 Spring; 7(1): 195-206.
95. Cornett CR, Markesbery WR, Ehmann WD: Imbalances of trace elements related to oxidative damage in Alzheimer's disease brain. *Neurotoxicology*, 1998 Jun; 19(3): 339-45.
96. Hock C, Drasch G, Golombowski S, et al: Increased blood mercury levels in patients with Alzheimer's disease. *J Neural Transm*, 1998; 105(1): 59-68.
97. Basun H, Forsell LG, Wetterberg L, et al: Met-

- als and trace elements in plasma and cerebrospinal fluid in normal aging and Alzheimer's disease. *J Neural Transm Park Dis Dement Sect*, 1991; 3(4): 231-58.
98. Ziff and Ziff, 33.
 99. Saxe SR, Snowdon DA, Wekstein MW, et al: Dental amalgam and cognitive function in older women: findings from the Nun Study. *J Am Dent Assoc*, 1995 Nov; 126(11): 1495-501.
 100. Ziff and Ziff, 34.
 101. *Ibid*.
 102. Olivieri G, Brack C, Muller-Spahn F, et al: Mercury induces cell cytotoxicity and oxidative stress and increases beta-amyloid secretion and tau phosphorylation in SHSY5Y neuroblastoma cells. *J Neurochem*, 2000 Jan; 74(1): 231-6.
 103. Leong CC, Syed NI, Lorscheider FL: Retrograde degeneration of neurite membrane structural integrity of nerve growth cones following in vitro exposure to mercury. *Neuroreport*, 2001 Mar 26; 12(4): 733-7.
 104. *Ibid*.
 105. Sibley R. *Report of International Conference on the Biocompatibility of Materials*. Colorado State University, 1988, 21.
 106. *Stortebecker, 19-21*.
 107. Sibley RL, et al: *Psychometric evidence that mercury from silver dental fillings may be an etiological factor in depression, anger, and anxiety*.
 108. Huggins Diagnostic Center, *The Proper Amalgam Removal Booklet*, 17.
 109. Silver, *Natural Living Newsletter*, No. 32.
 110. Huggins, *Mercury*, 12.
 111. Swartzendruber DE, PhD: Adverse immunomodulatory effects of heavy metals in dental materials. *Int J of Biosocial Med Research*, 1990; 12(2): 134.
 112. Hultman P, Johansson U, Turley SJ, et al: Adverse immunological effects and immunity induced by dental amalgam and alloy in mice. *FASEB J*, 1994; 8: 1183-90.
 113. *Pendergrass*.
 114. *Swartzendruber*.
 115. Vimy MJ, Hooper DE, King WW, et al: Mercury from maternal "silver" tooth fillings in sheep and human breast milk. A source of neonatal exposure. Department of Medicine, Faculty of Medicine, University of Calgary, Alberta, Canada. *Biol Trace Elem Res*, 1997 Feb; 56(2): 143-52.
 116. *Quicksilver Associates*, 69-70.
 117. Summers AO, Wireman J, Vimy MJ, et al: Mercury released from dental "silver" fillings provokes an increase in mercury- and antibiotic-resistant bacteria in oral and intestinal floras of primates. *Antimicrob Agents Chemother*, 1993 Apr; 37(4): 825-34.
 118. *Quicksilver Associates*, 71.
 119. *Hahn, 2644-2645*.
 120. Huggins Diagnostic Center, *The Proper Amalgam Removal Booklet*, 7.
 121. Shaini FJ, Shelton RM, Marquis PM, et al: In vitro evaluation of the effect of freshly mixed amalgam and gallium-based alloy on the viability of primary periosteal and osteoblast cell cultures. *Biomaterials*, 2000 Jan; 21(2): 113-9.
 122. *Ibid*.
 123. Osborne JW, Albino JE: Psychological and medical effects of mercury intake from dental amalgam. A status report for the American Journal of Dentistry. *Am J Dent*, 1999 Jun; 12(3): 151-6.
 124. Shurtz JD, Mayhew RB, Cayton TG: Depression. Recognition and control. *Dent Clin North Am*, 1986 Oct; 30(4 Suppl): S55-65.
 125. Moller AT, Spangenberg JJ: Stress and coping amongst South African dentists in private practice. *J Dent Assoc S Afr*; 1996 Jun; 51(6): 347-57.
 126. Echeverria D, Heyer NJ, Martin MD, et al: Behavioral effects of low-level exposure to Hg0 among dentists. *Neurotoxicol Teratol*, 1995 Mar-Apr; 17(2): 161-8.
 127. Bittner AC, Echeverria D, Woods JS, et al: Behavioral effects of low-level exposure to Hg0 among dental professionals: a cross-study evaluation of psychomotor effects. *Neurotoxicol Teratol*, 1998 Jul-Aug; 20(4): 429-39.
 128. Echeverria D, Aposhian HV, Woods JS, et al: Neurobehavioral effects from exposure to dental amalgam Hg(o): new distinctions between recent exposure and Hg body burden. *FASEB J*, 1998 Aug; 12(11): 971-80.
 129. Arenholt-Bindslev D, Larsen AH: Mercury levels and discharge in waste water from dental clinics. *Water Air and Soil Pollution*, 1996 Jan; 86(1-4): 93-9.
 130. Mercury Free and Healthy, The Dental Amalgam Issue. DAMS Inc. along with Consumers for Dental Choice, A Project of the National Institute for Science, Law and Public Policy, Washington, DC. Mercury Free and Healthy, *The Dental Amalgam Issue. DAMS Inc. along with Consumers for Dental Choice*.
 131. Skare I, Engqvist A: National Institute of Occupational Health, Human exposure to mercury and silver released from dental amalgam restorations. *Arch Environ Health*, 1994 Sep-Oct; 49(5): 384-9.
 - 13.2 Association of Metropolitan Sewerage Agencies' Evaluation of Domestic Sources of Mercury. <http://www.amsa-cleanwater.org/pubs/mercury/mercury.htm>.

133. U. S. Justice Department legal action regarding amalgam.
134. EPA (Environmental Protection Agency) acting regional director's letter to *Ott Dental Supply Co.*, Jan 26, 1988.
135. Huggins, *Medical and Legal Implications*, 3.
136. Toxic Element Research Foundation (TERF). *Micromercurialism: Environment and Responsibility*, July 1987.
137. Toxic Element Research Foundation (TERF): Mercury's Effects in Human and Animal Biological Systems. July 16, 1990; 125.
138. *Report of ICBM conference*, 44.
139. Djerassi E, Berova N: The possibilities of allergic reaction from silver amalgam restorations. *Int Dent J*, 1969 Dec; 19(4): 481-8.
140. Miller EG, Perry WL, Wagner MJ: Prevalence of mercury hypersensitivity in dental students. *J Prosthet Dent*, August 1987; 58(2): 235-7.
141. International Academy of Oral Medicine and Toxicology (IAOMT), *A Scientific Response to the ADA Special Report and Statement of Confidence in Dental Amalgam*.
142. American Dental Association. "Frequently Asked Questions," www.ada.org/public/faq/
143. Environmental Dental Association.
144. Stanford, John W. PhD, Secretary CDMIE, *letter to the ADA*, May 22, 1986.
145. IAOMT, *A Scientific Response to the ADA Special Report and Statement of Confidence in Dental Amalgam*.
146. *Superior Court of the State of California, In and For the County of Santa Clara. Case No. 718228*.
147. Warren T: Reversing Alzheimer's disease. From www.lauralee.com/warren.htm.
148. *Environmental Dental Association*.
149. *Ibid*.
150. *Ibid*.
151. *National Institutes of Health: Technology Assessment Conference Statement, Effects and Side Effects of Dental Restorative Materials*. Aug 26-28, 1991.
152. Rep. Diane Watson introduces bill to end use of mercury in dental fillings. From www.toxicteeth.net.
153. *Ibid*.
154. *Ibid*.
155. *Ziff and Ziff, 25*.
156. Huggins, "Integrity vs. Intimidation."
157. From www.toxicteeth.net.
158. *Ibid*.
159. *A message from Executive Director Susan Haeger of Citizens for Health*, based in Boulder, CO.
160. *Ibid*.
161. Huggins, *Mercury, 4*.
162. Huggins Diagnostic Center, *The Proper Amalgam Removal Booklet*, 8.
163. ADA Resolution 42H-1986. Transaction 1986:536. Cited in IAOMT, A Scientific Response to the American Dental Association's Special Report and Statement of Confidence in Dental Amalgam. www.geocities.com/HotSprings/Villa/3934/dental/claims.html.
164. *ADA News*, Sept 7, 1987.
165. *Newsweek*.
166. Sandborgh-Englund G, Elinder CG, Langworth S, et al: Mercury in biological fluids after amalgam removal. *J Dent Res*, 1998 Apr; 77(4): 615-24.
167. *Kidd*.
168. *Ibid*.
169. Barrister SF: *It is more probable than not that we will soon become as mad as hatters*. (Publication and date unknown), 12.
170. From an interview conducted by Gary Null as part of an investigative journalism series on mercury amalgam for his "Natural Living" radio program. Quoted material comes from the transcription of the program.
171. Newspaper article, *Svenska Dagbladet (Sweden)*, May 20, 1987.
172. Press release, the Green Group in the European Parliament, Luxembourg. Dental amalgams and heavy metals: what risks for health and the environment. Jan 7 and 8, 1999.
173. *Ibid*.
174. *Lohyn*, Part A, p. 4.
175. Gammal R: *Personal communication with Dr. Martin Feldman*, April 24, 2002.
176. *Dental amalgam and mercury in dentistry. Report of an NHMRC working party*. February 1999.
177. IAOMT, A Scientific Response to the ADA Special Report.
178. *Hahn, et al*.
179. Penzer V, MD: Amalgam toxicity: grand deception. *Int J Orthod*, 1986 Spring; 24(1-2): 21-4.
180. Nine Broadcast Plaza, *television program, WOR-TV*, Secaucus, NJ, Oct 17, 1990.