Facts about Mercury and Dental Amalgam

(with Medical Study References)

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I. Toxic metals such as mercury, lead, cadmium, etc. have been documented to be neurotoxic, immunotoxic, reproductive/developmental toxins that according to U.S. Government agencies cause adverse health effects and learning disabilities to millions in the U.S. each year, especially children and the elderly(105,160). Exposure of humans and animals to toxic metals such as mercury, cadmium, lead, copper, aluminum, arsenic, chromium, manganese, etc. is widespread and in many areas increasing. . The U.S. Center for Disease Control(276) ranks toxic metals as the number one environmental health threat to children. According to an EPA/ATSDR assessment, the toxic metals mercury, lead, arsenic, and cadmium are all ranked in the top 7 toxics having the most adverse health effects on the public based on toxicity and current exposure levels in the U.S., with nickel and chromium also highly listed. While there are large numbers of neurological and immune conditions among adults, the incidence of neurotoxic or immune reactive conditions in infants such as autism, scizophrenia, ADD, dyslexia, learning disabilities, etc. have been increasing especially rapidly in recent years(2,276,409,441). A recent report by the National Research Council found that 50% of all pregnancies in the U.S. are now resulting in prenatal or postnatal mortality, significant birth defects, or otherwise chronically unhealthy babies(441). Exposure to toxic chemcials or environmental factors appear to be a factor in as much as 28 percent of the 4 million children born each year(441), with 1 in 6 having one of the neurological conditions previously listed. EPA estimates that over 3 million of these are related to lead or mercury toxicity(2,276,409).

While there is considerable commonality to the health effects commonly caused by these toxic metals, and effects are cumulative and synergistic in many cases, this paper will concentrate on the health effects of elemental mercury from amalgam fillings. Studies have found considerable genetic variability in susceptibility to toxic metals as well. The public appears to be generally unaware that considerable scientific evidence supports that mercury is the metal causing the most widespread adverse health effects to the public, and amalgam fillings have been well documented to be the number one source of exposure of mercury to most people, with exposure levels often exceeding Government health guidelines and levels documented to cause adverse health effects.

II. Toxicity and Health Effects of Mercury

1. Dental amalgam contains about 50 % mercury. The average filling has 1 gram of mercury and leaks mercury vapor continuously due to mercury's low vapor pressure along with loss due to galvanic action of mercury with dissimilar metals in the mouth(182,192,292,348,349), resulting in significant exposure for most with amalgam fillings(see Section III). Mercury vapor is transmitted rapidly throughout the body, easily crosses cell membranes, and like organic methyl mercury has significant toxic effects at much lower levels of exposure than other inorganic mercury forms(38,281,287,304,329). According to the U.S. EPA & ATSDR, mercury is among the top 3 toxic substances adversely affecting large numbers of people(217), and amalgam is the number one source of exposure for most people(see III).

2. Mercury is the most toxic of the toxic metals. Mercury (vapor) is carried by the blood to cells in all organs of the body where it:

(a) is cytotoxic(kills cells) (2,21,27,36,56,147,148,150,160,210,259,295,333/333)

(b) penetrates and damages the blood brain barrier(311), resulting in accumulation of mercury and other toxic substances in the brain(14,20,25,85, 99,175,273,301/262,274); also accumulates in the motor function areas of the brain and CNS(48,291,327,329).

© is neurotoxic(kills brain and nerve cells): damages brain cells and nerve cells

(19,27,34,36,43,69,70,147,148,175,207, 211,273, 291,295,327,329,301,303,395/39,262,274,303); generates high levels of reactive oxygen species(ROS) and oxidative stress, depletes glutathione and thiols causing increased neurotoxicity from interactions of ROS, glutamate, and dopamine(13,56,98,102,126,145,169,170,184,213,219, 250, 257,259,286,290,291,302,324,326,329,424); kills or inhibits production of brain tubulin cells (66,67,161,166, 207,300); inhibits production of neurotransmitters by inhibiting: calcium-dependent neurotransmitter release(372,432), dihydroteridine reductase(27,122,257,333), nitric oxide synthase(259), blocking neurotransmitter amino acids(438), and effecting phenylalanine, seratonin, tyrosine and tryptophan transport to neurons (34,122,126,257,285, 288,333,372,374,438/255,333)

(d) is immunotoxic(damages and inhibits immune T-cells, B-cells, neutrophil function, etc.) (17,27,31,38,44,45,46,60,127,128,129,130,152,155,165,181,226,252,270,285,316,355/272) and induces ANA antibodies and autoimmune disease(38,43,45,59,60,118,131,181,234,269,270,313,314,334,342,343)

(e) is nephrotoxic(toxic to kidneys) (14,20,203,223,260,268,334)

(f) is endocrine system-disrupting chemical(accumulates in pituitary gland and damages or inhibits pituitary glands hormonal functions at very low levels(9,19,20,25,85,99,105,273,312,327,348,369/274), adrenal gland function(84,369,381), thyroid gland function(50,212,369), and disrupts enzyme production processes at very low levels of exposure (9,13,33,56,111,194,348,355,410-412)

(g) exposure to mercury vapor (or methyl mercury) causes rapid transmittal through the placenta to the fetus (20,22-24,27,38,39,61,112,186,281,287,304,311,338,339,348,361,366,20/4,22,37,39,41,42) and significant developmental effects-much more damage to the fetus than for maternal exposure to inorganic mercury and at lower exposure levels than for for organic mercury(287,304,etc.).

(h) reproductive and developmental toxin (2,4,9,10,22,23,24,37,38,41,61,105,149,160,275,276,281,305,338, 361,367,381,20/4,39,55,149,162,255,308,339,357); damages DNA(296,327,272,392,142,38,41,42) and inhibits DNA & RNA synthesis(114/149); damages sperm, lowers sperm counts and reduces motility. (4,37,104.105,159,160/4, 55,162); causes menstrual disturbances (9,27,146); reduces bloods ability to transport oxygen to fetus and transport of essential nutrients including amino acids, glucose, magnesium, zinc and Vit B12(43,96,198,263,264,338,339,347,427); depresses enzyme isocitric dehydrogenase (ICD) in fetus, causes reduced iodine uptake & hypothyroidism(50,91,212,222,369) & learning deficits; causes learning disabilities and impairment, and reduction in IQ(1,3,38,110,160,285c,263,264/39), causes infertility (4,9,10,24,38,121,146,357,365,367/4,10,55,162), causes birth defects (23,35,37,38,110,142,241,338c/241).

(i) prenatal/early postnatal exposure affects level of nerve growth factor in the brain,impairs astrocyte function, and causes imbalances in development of brain(38,119,161,175,194,305/175,255,39)

(j) causes cardiovascular damage and disease: including damage to vascular endothelial cells, damage to sarcoplasmic reticula, sarcolemma, and contractile proteins, increased white cell count, decreased oxyhemoglobin level, high blood pressure, tachycardia, inhibits cytochrome P450/heme synthesis(84), and increased risk of acute myocardial infarction (35,59,202,205,212,232,306,310,351/201,308).

(k) causes immune system damage resulting in allergies, asthma, lupus,chronic fatigue syndrome(CFS),and multiple sensitivities(MCS) (8,17,45,46,52,60,75,86,87,90,97,101,128,129,131,154,168,181,212, 226, 228,230,234,265, 267,296,313,342, 388/272) and neutrophil functional impairment(285/59,etc.).

(l) causes interruption of the cytochromeC oxidase system/ATP energy function(43,84,232,338c,35) and progressive coproporphyrinuria, resulting in low energy, digestive problems, and porphyrins in urine (34,69,70,73,210,212,226,232,260)

(m) inhibition of immune system facilitates increased damage by bacterial, viral, and fungal infections (17,45,59,129,131,251,296,350,40), and increased antibiotic resistance(116,117,161,258,389,53).

(n) mercury causes significant destruction of stomach and intestine epithelial cells, resulting in damage to stomach lining(leaky gut)(222,Shelton,228) and accumulation of heliobacter pylori, a suspected major factor in stomach ulcers and stomach cancer(256).

(o) causes mitochondrial release of calcium induced by modification of the--SH groups of proteins (1,21,35,38,43,329,333,432),as well as damaging enzymatic process(33,96,111,194,252,338,410-412) resulting in improper cysteine regulation(194), inhibited glucose transfer(338,254), damaged sulfur oxidation processes(33,338), and reduced glutathione availability (necessary for detoxification)(13,126,54).

3. Mercury has been well documented to be an endocrine system disrupting chemical in animals and people, disrupting function of the pituitary gland, thyroid gland, enzyme production processes, and many hormonal functions at very low levels of exposure . Mercury (especially mercury vapor) rapidly crosses the blood brain

barrier and is stored preferentially in the pituitary gland, hypothalamus, and occipital cortex in direct proportion to the number and extent of dental amalgam surfaces (1,14,16,19,20,25,34,38,61,85,99,162,211, 273,274,287,327,348,360,366,369) Thus mercury has a greater effect on the functions of these areas. The pituitary gland controls many of the body's endocrine system functions and secretes hormones that control most bodily processes, including the immune system and reproductive systems . One study found mercury levels in the pituitary gland ranged from 6.3 to 77 ppb(85), while another(348) found the mean level to be 30ppb- levels found to be neurotoxic and cytotoxic in animal studies. The hypothalamus regulates body temperature and many metabolic processes. Mercury damage thus commonly results in poor bodily temperature control, in addition to many problems caused by hormonal imbalances. Such hormonal secretions are affected at levels of mercury exposure much lower than the acute toxicity effects normally tested, as previously confirmed by hormonal/reproductive problems in animal populations(104,381). Mercury also damages the blood brain barrier and facilitates penetration of the brain by other toxic metals and substances(311).

4. Mercury's biochemical damage at the cellular level include DNA damage, inhibition of DNA and RNA synthesis(4,38,41,42,114,142,197,272,296,392/149); alteration of protein structure(33,111,114,194,252/114); alteration of the transport of calcium(333,43,96,254,329,432); inhibitation of glucose transport(338,254), and of enzyme function and other essential nutrients(96,198,254,263,264,338,339,347,410-412); induction of free radical formation(13,54), depletion of cellular gluthathione(necessary for detoxification processes) (111,126), inhibition of glutathione peroxidase enzyme(13), endothelial cell damage(202), abnormal migration of neurons in the cerebral cortex(149), and immune system damage (34,38,111,194, 226,252,272,316,325,355). Oxidative stress and reactive oxygen species(ROS) have been implicated as major factors in neurological disorders including stroke, PD, Alzheimer's, ALS, etc.(13,56,84,98,145,169,207b,424). Mercury induced lipid peroxidation has been found to be a major factor in mercury's neurotoxicity, along with leading to decreased levels of glutathione peroxidation and superoxide dismustase(SOD)(13). Only a few micrograms of mercury severely disturb cellular function and inhibit nerve growth(175,147,175,226,255,305). Exposure to mercury results in metalloprotein compounds that have genetic effects, having both structural and catalytic effects on gene expression(114,241,296). Some of the processes affected by such metalloprotein control of genes include cellular respiration, metabolism, enzymatic processes, metal-specific homeostasis, and adrenal stress response systems. Significant psysiological changes occur when metal ion concentrations exceed threshold levels. Such metalloprotein formation also appears to have a relation to autoimmune reactions in significant numbers of people(114,60,313,342,368,369). Of a population of over 3000 tested by the immune lymphocyte reactivity test(MELISA,60,275), 22% tested positive for inorganic mercury and 8% for methyl mercury .

A direct mechinism involving mercury's inhibition of cellular enzymatic processes by binding with the hydroxyl radical(SH) in amino acids appears to be a major part of the connection to allergic/immune reactive conditions such as autism, schizophrenia, eczema, psoriasis(375,385,408,413,419,438,439,33), and allergies(410-412,etc.). For example mercury has been found to strongly inhibit the activity of dipeptyl peptidase (DPP IV) which is required in the digestion of the milk protein cassein(411,412) as well as of xanthine oxidase(439). Studies involving a large sample of autistic and schizophrenic patients found that over 90 % of those tested had high levels of the milk protein beta-casomorphin-7 in their blood and urine and defective enzymatic processes for digesting milk protein(410). Elimination of milk products from the diet has been found to improve the condition. Such populations have also been found to have high levels of mercury and to recover after mercury detox(413,60,313). As mercury levels are reduced the protein binding is reduced and improvement in the enzymatic process occurs. Additional cellular level enzymatic effects of mercury's binding with proteins include blockage of sulfur oxidation processes(33,114,438), enzymatic processes involving vitimins B6 and B12(418), effects on the cytochrome-C energy processes(43,84,232,338c,35), along with mercury's adverse effects on cellular mineral levels of calcium, magnesium, zinc, and lithium(43,96,198,333,386,427,432,38). And along with these blockages of cellular enzymatic processes, mercury has been found to cause additional neurological and immune system effects in many through immune/autoimmune reactions (60,313,314).

But the effect on the immune system of exposure to various toxic substances such as toxic metals and environmental pollutants has also been found to have additive or synergistic effects and to be a factor in increasing eczema, allergies, asthma, and sensitivity to other lesser allergens. Most of the children tested for toxic exposures have found high or reactive levels of other toxic metals, and organochlorine compounds(413,313,414). Much mercury in saliva and the brain is also organic (220,272), since mouth bacteria and other organisms in the body methylate inorganic mercury to organic mercury(51, 81,225). Bacteria also oxidize mercury vapor to the water soluble, ionic form Hg(II) (431).

5. Because of the extreme toxicity of mercury, only ½ gram is required to contaminate a 10 acre lake to the extent that a health warning would be issued by the government to not eat the fish(151,160). Over half the rivers and lakes in Florida have such health warnings(160). Some Florida panthers that eat birds and animals that eat

fish containing very low levels of mercury(about 1 part per million) have died from chronic mercury poisoning(104,160). Since mercury is an estrogenic chemical and reproductive toxin, the majority of the rest cannot reproduce. The average male Florida panther has higher estrogen levels than females, due to the estrogenic properties of mercury(105,160). Similar is true of some other animals at the top of the food chain like alligators, which are affected by mercury and other hormone disrupting chemicals..

6. In addition to having estrogenic effects, mercury has other documented hormonal effects including effects on the reproductive system resulting in lowered sperm counts, defective sperm cells, and lowered testosterone levels in males; menstrual disturbances and infertility in women; and increased neurological problems related to lowered levels of neurotransmitters dopamine, serotonin, and noreprenephrine (4,9,38,104,105,107,140,141,275,276, 288,290,365,367,372,381,432,438).

7. An average amalgam filling contains over ½ gram of mercury, and the average adult had at least 5 grams of mercury in fillings(unless most has vaporized). Mercury in solid form is not stable, having low vapor pressure and being subject to galvanic action with other metals in an oral environment(182,192,292,348,349),so that within 10 years up to half has been found to have been transferred to the and body of the host(34,35,182, & section III).

8. Elemental mercury vapor is more rapidly transmitted throughout the body than most other forms of mercury and has more much toxic effects on the CNS and other parts of the body than inorganic mercury due to its much greater capacity to cross cell membranes, according to the World Health Organization and other studies (38,183, 282,287,360,section III). Mercury vapor rapidly crosses the blood-brain barrier(14,85,311) and placenta of pregnant women (20,22-24,27,38,105,162,186,231,281,287,304,308, 311,361) Developmental, learning, and behavioral effects have been found from mercury vapor at much lower levels than for exposure to methyl mercury(287,304). Similarly for inhibition of some essential cellular processes(333,338,329).

9. Running shoes with ½ gram of mercury in the heels were banned by several states, because the amount of mercury was considered dangerous to public health and created a serious disposal problem. Mercury from dental offices and human waste from people with amalgam fillings has much higher levels and is a major source of mercury in Florida waters. One study found dental offices discharge into waste water between 65 and 842 milligrams per dentist per day(231), amounting to several hundred grams per year per office. This is in addition to air emissions. Additionally cremation of those with amalgam fillings adds to air emissions and deposition onto land and lakes. A study in Switzerland found that in that small country, cremation released over 65 kilograms of mercury per year as emissions, often exceeding site air mercury standards(420), while another Swiss study found mercury levels during cremation of a person with amalgam fillings as high as 200 micrograms per cubic meter(considerably higher than U.S. mercury standards). The amount of mercury in the mouth of a person with fillings was on average 2.5 grams, enough to contaminate 5 ten acre lakes to the extent there would be dangerous levels in fish(151). A Japanese study estimated mercury emissions from a small crematorium there as 26 grams per day(421). A study in Sweden found significant occupational and environmental exposures at cremetoria, and since the requirement to install selenium filters mercury emission levels in crematoria have been reduced 85%(422).

10. Studies have found that levels of exposure to the toxic metals mercury, cadmium, and lead have major effects on classroom behavior, learning ability, and also in mental patients and criminals behavior(3,160).

Studies have found that both genetic susceptability and environmental exposures are a factor in xenobiotic related effects and disease propagation. Large numbers of animal studies have documented that genetically susceptable strains are more affected by xenobiotic exposures than less susceptable strains(234,425,526,etc.). Some genetic types are susceptable to mercury induced autoimmunity and some are resistant and thus much less affected(234,425,383). Studies found that mercury causes or accelerates various systemic conditions in a strain dependent manner, and that lower levels of exposure adversely affect some strains but not others, including inducing of autoimmunity. Also when a condition has been initiated and exposure levels decline, autoimmune antibodies also decline in animals or humans(233,234c,60,368,405). One genetic factor in Hg induced autoimmunity is major histocompatibility complex(MHC) linked. Both immune cell type Th1 and Th2 cytokine responses are involved in autoimmunity(425c). One genetic difference found in animals and humans is cellular retention differences for metals related to the ability to excrete mercury(426). For example it has been found that individuals with genetic blood factor type APOE-4 do not excrete mercury readily and bioaccumulate mercury, resulting in susceptability to chronic autoimmune conditions such as Alzheimer's, Parkinsons, etc. as early as age 40, whereas those with type APOE-2 readily excrete mercury and are less susceptable. Those with type APOE-3 are intermediate to the other 2 types.

11. Long term occupational exposure to low levels of mercury can induce slight cognitive deficits, lability, fatigue, decreased stress tolerance, etc. Higher levels have been found to cause more serious neurological problems (119,128,285,etc.). Occupational exposure studies have found mercury impairs the body's ability to kill Candida albicans by impairment of the lytic activity of neutrophils and myeloperoxidase in workers whose mercury excretion levels are withing current safety limits(285,404). Such levels of mercury exposure were also found to inhibit cellular respiratory burst. A population of plant workers with average mercury excretion of 20 ug/ g creatinine was found to have long lasting impairment of neutrophil function. Another study(59) found such impairment of neutraphils decreases the body's ability to combat viruses such as those that cause heart damage, resulting in more inflamatory damage. Another group of workers with average excretion rates of 24.7 ug/ g creatinine had long lasting increases in humoral immunological stimulation of IgG, IgA, and IgM levels. Other studies(285b,g) found that workers exposed at high levels at least 20 years previous(urine peak levels above 600 ug/L demonstrated significantly decreased strength, decreased coordination, increased tremor, decreased sensation, polyneuropathy, etc. Significant correlations between increasing urine mercury concentrations and prolonged motor and sensory distal latencies were established(285g). Elemental mercury can affect both motor and sensory peripheral nerve conduction and the degree of involvement is related to time-integrated urine mercury concentrations.

Another study found that many of the symptoms and signs of chronic candidiasis, multiple chemical sensitivity and chronic fatigue syndromes are identical to those of chronic mercurialism and remit after removal of amalgam combined with appropriate supplementation and gave evidence to implicate amalgam as the only underlying etiologic factor that is common to all(404).

Other studies(285c) found that mercury at levels below the current occupational safety limit causes adverse effects on mood, personality, and memory- with effects on memory at very low exposure levels.
More studies found that long term exposure causes increased micronuclei in lymphocytes and significantly increased IgE levels at exposures below current safety levels(128), as well as maternal exposure being linked to mental retardation(110) and birth defects(23,35,37,38,142,241,361,338c/241).

III. Systemic Mercury Intake Level from Amalgam Fillings

1. The tolerable daily exposure level for mercury developed in a report for Health Canada is .014 micrograms/kilogram body weight(ug/kg) or approximately 1 ug/day for average adult(217). The U.S. EPA Health Standard for elemental mercury exposure(vapor) is 0.3 micrograms per cubic meter of air(2). The U.S. ATSDR health standard(MRL) for mercury vapor is 0.2 ug/ M3 of air, and the MRL for methyl mercury is 0.3 ug/kg body weight/day(217). For the average adult breathing 20 M3 of air per day, this amounts to an exposure of 4 or 6 ug/day for the 2 elemental mercury standards. The EPA health guideline for methyl mercury is 0.1 ug/kg body weight per day or 7 ug for the average adult(2), or approx. 14 ug for the ATSDR acute oral toxicicity standard. Since mercury is methylized in the body, some of both types are present in the body. The older World Health Organization(183) mercury health guideline(PTWI) is 300 ug per week total exposure or approx. 42 ug/day.

2. Mercury in the presence of other metals in the oral environment undergoes galvanic action, causing movement out of amalgam and into the oral mucosa and saliva(174,192,436). Mercury in solid form is not stable due to low vapor pressure and evaporates continuously from amalgam fillings in the mouth, being transferred over a period of time to the host(15-19,26,31,36,79,83,211,182,183,199,298,299,303,332,335,371). The daily total exposure of mercury from fillings is from 3 to 1000 micrograms per day, with the average exposure being above 10 micrograms per day and the average uptake over 5 ug/day (183,199,209,18,19,77,83, 85,100,335,352,371,etc.). (see further details continued)

A large study was carried out at the Univ. Of Tubingen Health Clinic in which the level of mercury in saliva of 20,000 persons with amalgam fillings was measured(199). The level of mercury in unstimulated saliva was found to average 11.6 ug Hg/L, with the average after chewing being 3 times this level. Several were found to have mercury levels over 1100 ug/L, 1 % had unstimulated levels over 200 ug/L, and 10 % had unstimulated mercury saliva levels of over 100 ug/L.. The level of mercury in saliva has been found to be proportional to the number of amalgam fillings, and generally was higher for those with more fillings. The following table gives the average daily mercury exposure from saliva alone for those tested, based on the average levels found per number of fillings and using daily saliva volumes of 890 ml for unstimulated saliva flow and 80 ml for stimulated flow (estimated from measurements made in the study and comparisons to other studies). It also gives the 84th percentile mercury exposure from saliva for the 20,000 tested by number of fillings. Note that 16% of all of those tested with 4 amalgam fillings had daily exposure from their amalgam fillings of over 17 ug per day, and even more so for those with more than 4 fillings.

Table: Average daily mercury exposure in saliva by number of amalgam fillings(199)

Number of fillings:	4	5	6	7	8	9	10	11	12	13	14	15	16
Av. Daily Hg(ug)	6.5	8	9.5	11	12.4	14	15.4	16.9	18.3	19.8	21.3	22.8	24.3
84th percentile(ug)	17	23.5	26	30.5	35	41.5	43.8	48.6	50.3	46.7	56.6	61.4	64.5

Saliva tests for mercury are commonly performed in Europe, and many other studies have been carried out with generally comparable results(292,315,79,9b,335,179,317,352). Another large German study(352) found significantly higher levels than the study summarized here, with some with exposure levels over 1000 ug/day. Three studies that looked at a population with more than 12 fillings found generally higher levels than this study, with average mercury level in unstimulated saliva of 29 ug/L(18), 32.7 ug/L (292c), and 175 ug/day(352). The average for those with 4 or less fillings was 8 ug/L(18). While it will be seen that there is a significant correlation between exposure levels and number of amalgam surfaces and exposure generally increases as number of fillings increases, there is considerable variability for a given number of fillings. Some of the factors that will be seen to influence this variability include composition of the amalgam, whether person chews gum or drinks hot liquids, bruxism, oral environmental factors, type of tooth patse used, etc.

The Tubingen study did not assess the significant exposure route of intraoral air and lungs. One study that looked at this estimated a daily average burden of 20 ug from ionized mercury from amalgam fillings absorbed through the lungs(191), while a Norwegian study found the average level in oral air to be 0.8 ug/M3(176). Another study at a Swedish University(335) measured intraoral air mercury levels from fillings of from 20 to 125 ug per day, for persons with from 18 to 82 filling surfaces. Another study found similar results(83), and some individuals have been found to have intraoral air mercury levels above 400 ug/ M3 (319). Most of those whose intraoral air mercury levels were measured exceeded Gov't health guidelines for workplace exposure(2).

The studies also determined that the number of fillings is the most important factor related to mercury level, with age of filling being much less significant(319b). Different filling composition/manufacturer can also make a difference in exposure levels(as will be further discussed). The authors of the Tubingen study calculated that based on the test results with estimates of mercury from food and oral air included, over 40 % of those tested in the study received daily mercury exposure higher than the WHO standard(PTWI). As can be seen most people with several fillings have daily exposure exceeding the Health Canada TDE and the U.S. EPA and ATSDR health guideline for mercury(2,209,199,etc.), and many tested in past studies have exceeded the older and higher WHO guideline for mercury(183), without consideration of exposure from food, etc..

3. The main exposure paths for mercury from amalgam fillings are absorption by the lungs from intraoral air; vapor absorbed by saliva or swallowed; amalgam particles swallowed; and membrane, olfactory, venous, and neural path transfer of mercury absorbed by oral mucosa, gums, etc. (6,17,18,31,34,77,79,83,94,133,174,182,209,211,216,222,319,335,348,364,436) A study at Stockholm Univ.(335) made an effort to determine the respective parts in exposure made by these paths. It found that the majority of excretion is through feces, and that the majority of mercury exposure was from elemental vapor. Daily exposure from intraoral air ranged from 20 to 125 ug of mercury vapor, for subjects with number of filling surfaces ranging from 18 to 82. Daily excretion through feces amounted to from 30 to 190 ug of mercury, being more variable than other paths. Other studies had similar findings(6,15,16,18,19,25,31,36,79,80,83,115,196,386.)

The feces mercury was essentially all inorganic with particles making up at most 25%, and the majority being mercury sulfuhydryl compounds- likely originating as vapor. Their study and others reviewed found that at least 80% of mercury vapor reaching the lungs is absorbed and enters the blood from which it is taken to all other parts of the body(335,348,349,363). Elemental mercury swallowed in saliva can be absorbed in the digestive tract by the blood or bound in sulfhydryl compounds and excreted through the feces. A review determined that approx.20 % of swallowed mercury sulfhydryl compounds are absorbed in the digestive tract, but approx 60% of swallowed mercury vapor is absorbed(292,335,348). At least 80% of particle mercury is excreted. Approx. 80% of swallowed methyl mercury is absorbed(335,199,etc.)e, with most of the rest being converted to inorganic forms apparently. The primary detoxification/excretion pathway for mercury absorbed by the body is as mercury-glutathione compounds through the liver/bile loop to feces(111,252), but some mercury is also excreted though the kidneys in urine and in sweat. The range of mercury excreted in urine per day by those with amalgams is usually less than 15 ug(6,49,83,138,174,335,etc.), but some patients are much higher(93). A large NIDH study of the U.S. military population(49) with an average of 19.9 amalgam surfaces and range of 0 to 60 surfaces found the average urine level was 3.1 ug/L, with 93% being inorganic mercury. The average in those with amalgam was 4.5 times that of controls and more than the U.S. EPA maximum limit for mercury in drinking water(218). The avergage level of those with over 49 surfaces was over 8 times that of controls. The same study found that the average blood level was 2.55 ug/L, with 79 % being organic mercuy. The total mercury level had a significant correlation to the number of amalgam fillings, with fillings appearing to be

reponsible for over 75% of total mercury. From the study results it was found that each 10 amalgam surfaces increased urine mercury by approx. 1 ug/L. A study of mercury species found blood mercury was 89% organic and urine mercury was 87% inorganic(349b), whicle another study(363) found on average 77% of the mercury in the occipital cortex was inorganic. In a population of women tested In the Middle East(254), the number of fillings was highly correlated with the mercury level in urine, mean= 7 ug/L. Nutrient transport and renal function were also found to be adversely affected by higher levels of mercury in the urine.

As is known from autopsy studies for those with chronic exposure such as amalgam fillings (1,14,17,20,31,34,85,94), mercury also bioaccumulates in the brain/CNS(301,274,327,329,348,18,19,85),liver, kidneys, (14,85)heart(59,205,348)), and oral mucosa(174,192,436) with the half life in the brain being over 20 years. Elemental mercury vapor is transmitted throughout the body via the blood and readily enters cells and crosses the blood-brain barrier, and the placenta of pregnant women(38,61,287,311,361), at much higher levels than inorganic mercury and also higher levels than organic mercury. Significant levels are able to cross the blood brain barrier, placenta, and also cellular membranes into major organs such as the heart since the oxidation rate of Hg0 though relatively fast is slower than the time required by pumped blood to reach these organs(290,370). Thus the level in the brain and heart is higher after exposure to Hg vapor than for other forms(360,370). While mercury vapor and methyl Hg readily cross cell membranes and the blood-brain barrier, once in cells they form inorganic mercury that does not readily cross cell membranes or the blood brain barrier readily and is responsible for the majority of toxicity effects. Thus inorganic mercury in the brain has a very long half life(274,etc.).

4. The average amalgam filling has approximately 0.5 grams(500,000 ug) of mercury. As much as 50% of mercury in fillings has been found to have vaporized after 5 years and 80% by 20 years(182,204). Mercury vapor from amalgam is the single largest source of systemic mercury intake for persons with amalgam fillings, ranging from 50 to 90 % of total exposure. (14,16,17,19,36,57,61,78-83,94,129,130,138,161,167,183, 191, 196,211,216,273,292,303,332,), averaging about 80% of total systemic intake. After filling replacement levels of mercury in the blood, urine, and feces typically temporarily are increased for a few days, but levels usually decline in blood and urine within 6 months to from 60 to 85% of the original levels(57,79,82,89,196,303). Mercury levels in saliva and feces usually decline between 80 to 95% (79,196,335,386)

5. Having dissimilar metals in the teeth(e.g.-gold and mercury) causes galvanic action, electrical currents, and much higher mercury vapor levels and levels in tissues. (182,192,292,348,349,390,19,25,27,29,30,47,48,100) Average mercury levels in gum tissue near amalgam fillings are about 200 ppm, and are the result of flow of mercury into the mucous membrane because of galvanic currents with the mucous membrane serving as cathode and amalgam as cathode(192). Average mercury levels are often 1000 ppm near a gold cap on an amalgam filling due to higher currents when gold is in contact with amalgam (30,25,35,48). These levels are among the highest levels ever measured in tissues of living organisms, exceeding the highest levels found in chronically exposed chloralkali workers, those who died in Minamata, or animals that died from mercury poisoning. Concentrations of mercury in oral mucosa for a population of patients with 6 or more amalgam fillings taken during oral surgery were 20 times the level of controls(174). German oral surgeons have found levels in the jaw bone under large amalgam fillings or gold crowns over amalgam as high as 5760 ppm with an average of 800 ppm(436). These levels are much higher than the FDA/EPA action level for prohibiting use of food with over 1 ppm mercury. Likewise the level is tremendously over the U.S. Dept. Of Health/EPA drinking water limit for mercury which is 2 parts per billion(218). Studies have shown that mercury in the gums such as from root caps for root canaled teeth result in chronic inflammation, in addtion to migration to other parts of the body(200,47). Mercury and silver from fillings can be seen in the tissues as amalgam “tatoos”, which have been found to accumulate in the oral mucosa as granules along collagen bundles, blood vessels, nerve sheaths, elastic fibers, membranes, striated muscle fibers, and acini of minor salivary glands. Dark granules are also present intracellularly within macrophasges, multinucleated giant cells, endothelial cells, and fibroblasts. There is in most cases chronic inflammatory response or macrophagic reaction the the metals(47), usually in the form of a foreingn body granuloma with multinucleated giant cells of the foreign body and Langhans types(192).

The component mix in amalgams has also been found to be an important factor in mercury vapor emissions. The level of mercury and copper released from high copper amalgam is as much as 50 times that of low copper amalgams(191). Studies have consistently found modern high copper non gamma-two amalgams have greater release of mercury vapor than conventional silver amalgams (298,299). While the non gamma-two amalgams were developed to be less corrosive and less prone to marginal fractures than conventional silver amalgams, they have been found to be instable in a different mechanism when subjected to wear/polishing/ chewing/ brushing: they form droplets of mercury on the surface of the amalgams(182,297). This has been found to be a factor in the much higher release of mercury vapor by the modern non gamma-two amalgams. Recent studies have concluded that because the high mercury release levels of modern amalgams, mercury poisoning from amalgam fillings is widespread throughout the population”(95,199,238). Numerous other studies also support this finding(Section IV).

Amalgam also releases significant amounts of silver, tin, and copper which also have toxic effects, with organic tin compounds formed in the body being even more neurotoxic than mercury(51,222,262)

7. Feces is the major path of excretion of mercury from the body, having a higher correlation to systemic body burden than urine or blood, which tend to correlate with recent exposure level (35,36,79,80,183, 278). For this reason many researchers consider feces to be the most reliable indicator of daily exposure level to mercury or other toxics. The average level of mercury in feces of those with fillings is over 1 ppm and approx. 10 times that of a similar group without fillings (79,80,83,335,386,25,), with significant numbers of those with several filings having over 10 ppm and 170 times those without fillings(80). The saliva test is another good test for daily mercury exposure, done commonly in Europe and representing one of the largest sources of mercury exposure.

There is only a weak correlation between blood or urine mercury levels and body burden or level in a target organ(36,157,183,278,11,etc.). Mercury vapor passes through the blood rapidly(half-life in blood is 3 seconds,370) and accumulates in other parts of the body such as the brain, kidneys, liver, thyroid gland, pituitary gland, etc. Thus blood test measures mostly recent exposure. As damage occurs to kidneys over time, mercury is less efficiently eliminated (11,36,57,183, 216,260), so urine tests are not reliable for body burden after long term exposure. Some researchers suggest hair offers a better indicator of mercury body burden than blood or urine(279), though still not totally reliable and may be a better indicator for organic mercury than inorganic. Hair was found to be significantly correlated with fish consumption, as well as with occupational dental exposure and to be a good medium for monitoring internal mercury exposure, except that external occupational exposure can also affect hair levels. Mercury hair level in a population sampled in Madrid Spain ranged from 1.3 to 92.5 ppm. This study found a significant positive correlation between maternal hair mercury and mercury level in nursing infants. Hair mercury levels did not have a significant correlation with urine mercury in one study(340) and did not have a significant correlation to number of fillings(350). One researcher suggests that mercury levels in hair of greater than 5 ppm are indicative of mercury intoxication.

A new test approved by the FDA for diagnosing damage that has been caused by toxic metals like mercury is the fractionated porphyrin test(260), that measures amount of damage as well as likely source. Provocation challenge tests after use of chemical chelators such as DMPS or DMSA also are effective at measuring body burden(57,58), but DMPS can be dangerous to some people- especially those still having amalgam fillings or those allergic to sulfur drugs or sulfites. Many studies using chemical chelators such as DMPS or DMSA have found post chelation levels to be poorly correlated with prechelation blood or urine levels(57,115,303), but one study (340) found a significant correlation between pre and post chelation values when using DMPS. Challange tests using DMPS or DMSA appear to have a better correlation with body burden and toxicity symptoms such as concentration , memory, and motor deficits(290)- with many studies finding a significant correration between post chelation mercury level and the number of amalgam surfaces(57,172,173,222,290,292,273,303). Several doctors use 16 ug/L as the upper bound for mercury after DMPS challange, and consider anyone with higher levels to have excess body burdern(222,352). However one study(290) found significant effects at lower levels. Some researchers believe DMSA has less adverse side effects than DMPS and prefer to use DMSA for chelation for this reason. Some studies have also found DMSA as more effective at removing mercury from the brain(58). Another chelator used for clogged arteries, EDTA, forms toxic compounds with mercury and can damage brain function(307). Use of EDTA may need to be restricted in those with high Hg levels. N-acetylcystein(NAC) has been found to be effective at increasing cellular glutathione levels and chelating mercury(54). Experienced doctors have also found additional zinc to be useful when chelating mercury(222) as well as counteracting mercury's oxidative damage(43). Zinc induces metallothionein which protects against oxidative damage and increases protective enzyme activities and glutathione which tend to inhibit lipid peroxidation and suppress mercury toxicity(430). Also lipoic acid has been found to dramatically increase excretion of inorganic mercury(over 12 fold), but to cause decreased excretion of organic mercury(54) and copper. Lipoic acid has a protective effect regarding lead or inorganic toxicity through its
antioxidant proprties, but should not be used with high copper. Zinc is a mercury and copper antgonist and can be used to lower copper levels aand protect against mercury damage.

8. The number of amalgam surfaces has a statistically significant correlation to :

(a) blood plasma mercury level (17,49,79,89,133,211)(usually not as strong as other measures)
(b) urine mercury level (38,49,57,76,77,79,82,83,134,138,167,176,254,303,332,335)
© oral air(16,18,100,176,335)
(d) saliva and oral mucosa(18,30,77,79,117,179,174,199,211,222,292,315,317)
(e) feces mercury (25,79,80,83,115,117,182,335,386)
(f) pituitary gland (19,20,25,85,99,273/274)
(g) brain occipital cortex (14,16,19,25,34,85,211,273,348,366/274)
(h) renal(kidney) cortex(14,16,19,20,85,273,348,366)
(I) liver(14,19,85,366)

(j) motor function areas of the brain & CNS: brain stem, cerebellum, rhombencephalon, dorsal root ganglia, and anterior horn motor neurons (48,291,327,329,etc.)
(k) fetal and infant liver/brain levels(61,112,186,231) related to maternal fillings.

9. A person with amalgam fillings has daily systemic intake from mercury vapor of between 3 and 70 micrograms of mercury, with the average being at least 7 micrograms(ug) per day (18,77,83,85,93,138,183,199,211,292,315,335). In a large German study, the median daily exposure for those with fillings through saliva was approx. 10 ug/day, 4% of those with fillings had daily exposure through saliva of over 80 ug/day, and 1% had over 160 ug/day(199). The methods and results of the Tubingen study(199) were similar to those of other German studies(292,315,9, 138, 317,335). Total intake is proportional to the number and extent of amalgam surfaces, but other factors such as chewing gum, drinking hot liquids, brushing or polishing, and using fluoride toothpaste significantly increase the intake(15,18,28,31,100,134-137,182, 183,199,209,211,292,317,319,348,349,350). Vapor emissions range up to 200 ug/M3 (35) and are much higher after chewing(137,319). After chewing, those with amalgams had levels over 50 times higher than those without, and the average level of exposure was 29 ug/day for those with at least 12 occlusal surfaces(18). At least 30% of those having amalgam fillings tested in a large German study had ingested mercury levels exceeding the WHO PTWI mercury standard of 43 ug/day (199,183), and over 50% of those with 6 or more fillings had daily exposures more than the U.S. EPA health guideline level(199) of 0.1 ug/kg body weight/day(199). The median daily exposure through saliva for those with 10 or more fillings was over 10 times that of those with no fillings(199,292,315,318). Mercury level in saliva has been found to give much better indication of body levels than blood or urine levels(36). Most people with fillings have daily exposure levels exceeding the U.S. ATSDR and EPA health guideline levels (2,36,83,89,183,199,209,217,261,292,335,93)

10. The blood and urine mercury load of a person with amalgam fillings is often 5 times that of a similar person without.(14,16,17,79,80,82,93,136,138, 303,315,317,318) The average blood level for one large population was 5 ug/l(176). Normal blood levels are less than 20 ppb, but health effects have been observed in patients in the upper part of this range. A Swedish study estimated the total amount mercury swallowed per day from intra-oral vapor was 10 micrograms per day(177),and a large German study(199) found median exposure through saliva alone for those with fillings to be about 10 ug/day, with many having several fillings with over 10 times that level. Other studies have found similar amounts(18,83,211,183,209).

11. Teeth are living tissue and have massive communication with the rest of the body via blood, lymph, and nerves. Mercury vapor (and bacteria in teeth) have paths to the rest of the body. (34,etc.) German studies of mercury loss from vapor in unstimulated saliva found the saliva of those with amalgams had at least 5 times as much mercury as for controls(138,199,292,315).

12. Mercury (especially mercury vapor) rapidly crosses the blood brain barrier and is stored preferentially in the pituitary gland, hypothalamus, and occipital cortex in direct proportion to the number and extent of amalgam surfaces.(14,19,20,25,34,38,85,99,273,274,287,348,366) Thus mercury has a greater effect on the functions of these areas. The range in one study was 2.4 to 28.7 ppb(85), and one study found on average that 77% of the mercury in the occipital cortex was inorganic(363).

13. Some mercury entering nasal passages is absorbed directly into the olfactory lobe and brain without coming from blood(34,35,182,222,348,364). Mercury also is transported along the axons of nerve fibres (5,25,34,35,327,329).

14. Mercury has a long half life in the body and over 20 years in the brain, and chronic low level intake results in a slow accumulation in body tissues. (20,34,35,38,85,etc.)

15. Methyl mercury is more toxic to some body processes than inorganic mercury. Mercury from amalgam is methylated by bacteria and candida albicans in the mouth and intestines(51,81,98,182,225). Oral bacteria streptococommus mitior,S.mutans, and S.sanguis were all found to methylate mercury(81). High levels of Vit B12 in the system also have been found to result in increased methyl mercury concentrations in the liver and brain(51). Methyl mercury is 10 times more potent in causing genetic damage than any other known chemical (Ramel, in(35)), and also crosses the blood-brain barrier readily. Once mercury vapor or methyl mercury are converted to inorganic mercury in cells or the brain, the mercury does not readily cross cell membranes or the blood-brain barrier. Thus mercury has a very long half life in the brain. N-acetylcysteine(NAC) has been found to be effective at increasing glutathione levels and chelating methyl mercury(54,126).

16. The level of mercury in the tissue of the fetus, new born, and young children is directly proportional to the number of amalgam surfaces in the mother's mouth. (20,23,61,112,210,361) The level of mercury in umbilical cord blood and placenta was higher than that in mother's blood(22,186). The saliva and feces of children with amalgams have approximately 10 times the level of mercury as children without(25,315,386), and much higher levels in saliva after chewing. A group of German children with amalgam fillings had urine mercury level 4 times that of a control group without amalgams(76), and in a Norwegian group with average age 12 there was a significant correlation between urine mercury level and number of amalgam fillings(167). The level of mercury in maternal hair was significantly correlated to level of mercury in nursing infants(279). One study found a 60% increase in average cord blood mercury level between 1980 and 1990 in Japan(186).

17. The fetal mercury content after maternal inhalation of mercury vapor was found to be higher than in the mother(4,etc.) Mercury from amalgam in the blood of pregnant women crosses the placenta and appears in amniotic fluid and fetal blood, liver, and pituitary gland soon after placement (20,22,23,31,36,61,162,186,281,348,366). Dental amalgams are the main source of mercury in breast milk(112,186,304,339,20). Milk increases the bioavailability of mercury(112,304,391) and mercury is often stored in breast milk and the fetus at much higher levels than that in the mother's tissues (19,20,22,23,61,112,186,210, 287,304). The level of mercury in breast milk was found to be significantly correlated with the number of amalgam fillings(61), with milk from mothers with 7 or more fillings having levels in milk approx. 10 times that of amalgam free mothers. The milk sampled ranged from 0.2 to 6.9 ug/L. Several authors suggest use of early mother's milk as a screen for potenital problems since it is correlated both to maternal and infant mercury levels. The highest level is in the pituitary gland of the fetus which affects development of the endocrine to be approx 0 times that for maternal exposure to an equivalent dose of inorganic mercury(281,287), and developmental behavioral effects from vapor have been found at levels considerably below that required for similar effects by methyl mercury(20,49,119c,264,287,304,338). The level of total mercury in nursing infants was significantly correlated to total mercury level in maternal hair(22,279).

18. There is a significant correlation between number of amalgam fillings of the mother and the level of the fetus and older infants(20,23,61,304), and also with the level in mother's milk (19,20,38,112, 304). Fertile women should not be exposed to vapor levels above government health guidelines(38,61,182,282) ;the U.S. ATSDR mercury health MRL of 0.2 mcg/M3 (2,217); or have amalgams placed or removed during pregnancy(20,182,231,304,etc.).

IV. Immune System Effects and Autoimmune Disease

1. Many thousands of people with symptoms of mercury toxicity have been found in tests to have high levels of mercury, and many thousands who have had amalgam fillings removed(most) have had health problems and symptoms alleviated or greatly improved(see Section VI). From clinical experience some of the symptoms of mercury sensitivity/mercury poisoning include chronic fatigue, dizziness, frequent urination, insomnia, headaches, chronic skin problems, metallic taste, gastrointestinal problems, asthma(8,97), stuffy nose, drycrusts in nose, rhinitis, plugged ears, ringing ears, chest pain, hyperventilation, diabetes, spacy feeling, chilly, chronic skin problems, immune and autoimmune diseases, cardiovascular problems and many types of neurological problems (26,34,35,36,38,45,59,60,69,70,71,75,91,109,148,165,204,212,199,246,255,268-270,290,291,294, 313,343). Amalgam results is chronic exposure rather than acute exposure and accumulation in body organs over time, so most health effects are of the chronic rather than acute in nature, but serious health problems have been documented to be related to amalgam and researchers have attributed some deaths as due to amalgam (356,32,245).

2. Mercury vapor exposure at very low levels adversely affects the immune system(17,27,31,38,45,60,84,118,129, 131,165,226,270,285,296,313,314,355368,369). From animal studies it has been determined that mercury damages T-cells by generating reactive oxygen species(ROS), depleting the thiol reserves of cells, damaging and decreasing the dimension of mitochondria, causing destruction of cytoplasmic organelles with loss of cell membrane integrity, inhibiting ability to secrete interleukin IL-1 and IL-2R, causing activation of glial cells to produce superoxide and nitric oxide, and inactivating or inhibiting enzyme systems involving the sulphydrol protein groups(226,424). Mercury caused adverse effects on both neutrophil and macrophage function and after depletion of thiol reserves, T-cells were susceptible to Hg induced cellular death (apoptosis).(226,272,355) Interferon syntheses was reduced in a concentration dependent manner with either mercury or methyl mercury as well as other immune functions(131), and low doses also induce aggregation of cell surface proteins and dramatic tyrosine phosporlation of cellular proteins related to asthma, allergic diseases such as eczema and lupus(234), and autoimmunity(181,314). One study found that insertion of amalgam fillings or nickel dental materials causes a supression of the number of T-lympocytes(270), and impairs

the T-4/T-8 ratio. Low T4/T8 ratio has been found to be a factor in lupus, anemia, MS, eczema, inflamatory bowel disease, and glomerulonephritis. Mercury induced autoimmunity in animals and humans has been found to be associated with mercury's expression of major histocompatibility complex(MHC) class II genes(314,181,226,425c). Both mercuric and methyl mercury chlorides caused dose dependent reduction in immune B-cell production. (316) B-cell expression of IgE receptors were significantly reduced(316,165), with a rapid and sustained elevation in intracellular levels of calcium induced(316,333). Both forms are immontoxic and cytotoxic ant very low levels seen in individuals. Mercury also inhibited B-cell and T-cell RNA and DNA synthesis. The inhibition of these functins by 50 % occurred rapidly at very low levels, in the range of 10 to 25 ug/L. All types of cells exhibited a dose dependent reduct in cellular glutathione when exposed to mercury, inhibiting generation of GSH by lumpocutes and moncytes(252). Workers occupationally exposed to mercury at levels within guidelines have been found to have impairment of lytic activity of neutrophils and reduced abiltiy of neutraphils to kill invaders such as candida(285,404). Immune Th1 cells inhibit candida by cytokine related activation of macrophages and neutraphils. Development of Th2 type immune responses deactivate such defenses(404b). Mercury inhibits macrophage and neutraphil defense against candida by its affects on Th1 and Th2 cytokine effects(181,285). Low doses also induced autoimmuntiy in some species(181,314,404,131,129,43). Another effect found is increase in the average blood white cell count significantly (35). The increased white count usually normalizes after amalgam removal. Mercury also blocks the immune function of magnesium and zinc (198,427,43,38). Several studies found adverse health effects at mercury vapor levels of 1 to 5 mcg/M3 (35). Large numbers of people undergoing amalgam removal have clinically demonstrated significant improvements in the immune system parameters discussed here and recovery and significant improvement in immune system problems in most cases surveryed(Section VI).

3. Mercury from amalgam interferes with production of cytokines that activate macrophage and neutraphils, disabling early control of viruses and leading to enhanced infection(131,251). Animal studies have confirmed that
mercury increases effects of the herpes simplex veris type 2 for example(131). Both mercuric and methyl mercury were equally highly toxic at the cellular level and in causing cell volume redcuctions(131). However methyl mercury inhibits macrophage functions such as migration and phagocytosis at lower levels.

4. Body mercury burden was found to play a role in resistant infections such as Chlamydia trachomatis and herpes family viral infections; it was found many cases can only be effectively treated by antibiotics after removal of body mercury burden(cilantro tablets were used with followup antibiotics)(251,131). Similar results have been found for treatment of cancer.

5. Mercury by its effect of weakening the immune system contributes to increased chronic diseases and cancer(91,180,237,239,222,234,355,38,40,etc,). Exposure to mercury vapor causes decreased zinc and methionine availability, depresses rates of methylation, and increased free radicals-all factors in increased suscepability to cancer(14,34,38,43,143,144,180,237,239,251,256,283). Amalgam fillings have also been found to be positively associated with mouth cancer(206,251,403).

6. Among a group of patients testing positive as allergic to mercury, low level mercury exposure was found to cause adverse immune system response, including reduction of in vitro production of tumor necrosis factor TNF alfa and interleukin-1. (131,152) Mercury also interrupts the cytochrome oxidase system, blocking the ATP energy function (35,43,84,232,338c) and impairing astrocyte function(119).. These effects often result in fatigue and reduced energy levels (35,60,119,140,141,182,202,212,232,235,313).

7. Toxic/allergic reactions to metals such as mercury often result in lichen planus lesions in oral mucosa or gums and play a roll in pathogenesis of periodontal disease. A high percentage of patients with oral mucosal problems along with other autoimmune problems such as CFS have significant immune reactions to mercury, palladium, gold, and nickel(60,118,313,81,90,212,313,342,368,369,375), including to mercury preservatives such as thimersol. 94% of such patients had significant immune reactions to inorganic mercury(MELISA test) and 72% had immune reactions to low concentrations of HgCl2(<0.5 ug/ml). 61% also had immune reaction to phenylHg, which has been commonly used in root canals and cosmetics(313). 10% of controls had significant immune reactions to HgCl and 8.3% to palladium. Removal of amalgam fillings usually results in cure of such lesions. (46,60,75,78,82, 86, 87,90,94,101,118,133,168,313). Other studies of patients suffering from chronic fatigue found similar results(369,375). Of 50 patients suffering from serious fatigue refered for MELISA test(369), over 70% had significant immune reaction to inorganic mercury and 50% to nickel, with most patients also reactive to one or more other metals such as palladium, cadmium, lead, and methyl mercury.
Mercury has been found to impair conversion of thyroid T4 hormone to the active T3 form as well

as causing autoimmune thyroiditis common to such patients(369,382). In general immune activation from toxics such as heavy metals resulting in cytokine release and abnormalities of the hypothalamus-pituitary-adrenal axis can cause changes in the brain, fatigue, and severe psycholgical symtoms(379-382,385,369,375,381,118,60) such as profound fatigue, muscosketal pain, sleep disturbances, gastrointestinal and neurological problems as are seen in CFS, fibromyalgia, and autoimmune thyroiditis. Such symptoms usually improve significantly after amalgam removal. Such hypersensitivity has been found most common in those with genetic predisposition to heavy metal sensitivity(369,60), such as found more frequently in patients with HLA-DRA antigens(383). A significant portions of the population appear to fall in this category.

8. Patients with other systemic neurological or immune symptoms such as arthritis, myalgia, eczema, CFS, MS, diabetes, etc. also often recover after amalgam replacement (60,212,313,342,368,369,section VI). Of a group of 86 patients with CFS symptoms, 78% reported significant health improvements after replacement of amalgam fillings within a relatively short period, and MELISA test found significant reduction in lymphocyte reactivity compared to pre removal tests(342,368). The improvement in symptoms and lymphocute reactivity imply that most of the Hg-induced lymphocyte reactivity is allergenic in nature. Although patch tests for mercury allergy are often given for unresolved oral symptoms, this is not generally recommended as a high percentage of such problems are resolved irrespective of the outcome of a patch test(87,86,90,101,168,etc.) Also using mercury in a patch test has resulted in some adverse health effects. A group of patients that had amalgams removed because of chronic health problems, was able to detect subjectively when a patch test used mercury salts in a double blind study(373).

Of the over 3,000 patients tested for lymphocyte reactivity to metals(342,368,375), the following were the percentages testing positive: nickel- 34%, inorganic mercury- 23%, phenol mercury- 13%, gold- 12%, cadmium- 11%, palladium- 11%, silver- 1%. Other studies have also found relatively high rates of allergic reactions to inorganic mercury and nickel(81,etc.). For groups with suspected autoimmune diseases such as neurological problems, CFS, and oral lichen planus; most of the patients tested positive to inorganic mercury and most of such patients health improved significantly and immune reactivity declined after amalgam removal. In a group of patients tested by MELISA before and after amalgam removal at a clinic in Uppsula Sweden, the patients reactivity to inorganic mercury, palladium, gold and phenyl mercury all had highly significant differences from the control group, with over 20 % being hihgly reactive to each of these metals(375). A high percentage were also reactive to nickel in both groups. After amalgam revoval the immune reactivity to all of these metals other than nickel declined significantly, and 76% reported significant long term health improvements after 2 years. Only 2% were worse. The study concluded that immune reactivity to mercury and palladium is common and appears to be allegenic/immune related in nature since immune reactivity declines when exposure levels are reduced. Such studies have also found that deficiencies in detoxification enzymes such as glutathione transfereases cause increased susceptibility to metals and other chemicals(384). Such deficiencies can be due to genetic predisposition, but are also known to be caused by acute or chronic toxic exposures. For MS and lupus patients, a high percentage tested positive to nickel and/or inorganic mercury.

A patch test was given to a large group of medical students to assess factors that lead to sensitization to mercury(132). 13% tested positive for allergy to mercury. Eating fish was not a significant factor between sensitive and non- sensitized students, but the sensitized group had a significantly higher average number of amalgam fillings and higher hair mercury levels. In a population of dental students tested, 44% were positive for allergy to mercury(156).

9. A high correlation has been found between patients subjectively diagnosed with CNS & systemic symptoms suggestive of mercury intoxication and immune reactivity to inorganic mercury(MELISA test,118) as well as with MRI positive patients for brain damage. 81% of the group with health complaints had pathological MRI results including signs of degeneration of the basal ganglia of the brain, but none in the controls. 60% of the symptom group tested positive for immune system reaction to mercury. Controls without CNS problems did not have such positive correlations. The authors concluded that immune reactions have an important role in development of brain lesions ,and amalgam fillings induce immune reactions in many patients (91,118)(270,286). Mercury,nickel,palladium, and gold induce autoimmunity in genetically predisposed or highly exposed individuals(314,234,130,342,). Tests have found a significant portion of people to be in this category and thus more affected by exposure to amalgam than others.

10. Low level mercury exposure(as well as other toxic metals) including exposure to amalgam fillings has been found to be associated with increased autoimmune diseases (19, 27,34,35,44,45,60,215,234,268,269,270, 313,314), including lupus(12,60,113,234),Chrons Disease,lichen planus(86,87,90,168), endometriosis (1,9,38,229). Silver also is released from amalgam fillings and stored in the body and has been shown to cause immune complex deposits, immune reactions and autoimmunity in animal studies (77,78,129,314).

11. Mercury exposure through fillings appears to be a major factor in chronic fatigue syndrome(CFS) through its effects on ATP and immune system(lymphocute reactivity, neutraphil activity, effects on T-cells and B-cells) and its promotion of growth of candida albicans in the body and the methylation of inorganic mercury by candida to the extremely toxic methyl mercury form which like mercury vapor crosses the blood-brain barrier and also damages and weakens the immune system(222,225,226,234,235,265,293,60,313,314,342,368,369, 404), and both inorganic and methyl mercury have been shown in animal studies to induce autoimmune reactions and disease in susceptible types through effects on immune system T cells (226,234,268,269,270,314,425,426/272.)

Spatial and temporal changes in intracellular calcium concentrations are critical for controlling gene expression and neurotransmitter release in neurons(432,438). Mercury alters calcium homeostasis and calcium levles in the brain and affects gene expression and neurotransmitter release through its effects on calcium, etc. Mercury inhibits sodium and potassium (N,K)ATPase in dose dependent manner and inhibits dopamine and noreprenephrine uptake by synaptosomes(288,50,270).

Mercury lymphocyte reactivity and effects on glutamate in the CNS induce CFS type symptoms including profound tiredness, musculoskeletal pain, sleep distubances, gastrointestinal and neurological problems along with other CFS symptoms and fibromyalgia(342,346,368,369). Mercury has been found to be a common cause of fibromyalgia(293,346,369). Glutamate is the most abundant amino acid in the body and in the CNS acts as excitory neurotransmitter(346,386,438), which also causes inflow of calcium. Astrocytes, a type of cell in the brain and CNS with the task of keeping clean the area around nerve cells, have a function of neutralizing excess glutamate by transforming it to glutamic acid. If astrocytes are not able to rapidly neutralize excess glutamate, then a buildup of glutamate and calcium occurs, causing swelling and neurotoxic effects(119,333). Mercury and other toxic metals inhibit astrocyte function in the brain and CNS(119), causing increased glutamate and calcium related neurotoxicity(119,333,226a) which are responsible for much of the fibromylgia symptoms. This is also a factor in conditions such as CFS, Parkinson's, and ALS(346,416). Animal studies have confirmed that increased levels of glutamate(or aspartate, another amino acid excitory neurotransmitter) cause increased sensitivity to pain , as well as higher body temperature- both found in CFS/fibromyalgia. Mercury and increased glutamate activate free radical forming processes like xanthine oxidase which produce oxygen radicals and oxidative neurological damage(346,142,13). Medical studies and doctors treating fibromylagia have found that supplements which cause a decrease in glutamate or protect against its effects have a positive effect on fibromyalgia. Some that have been found to be effective include Vit B6, methyl cobalamine(B12), L-carnitine, choline, ginseng, Ginkgo biloba,vitamins C and E, nicotine, and omega 3 fatty acids(fish and flaxseed oil)(417).

V. Medical Studies Finding Health Problems Related to Amalgam Fillings (other than immune)

1. Neurological problems are among the most common and serious and include memory loss, moodiness, depression, anger and sudden bursts of anger/rage(434), self-effacement, suicidal thoughts, lack of strength/force to resolve doubts or resist obsessions or compulsions, etc. Many studies of patients with major neurological diseases have found evidence amalgam fillings may play a major role in development of conditions such as depression(107,109,212,222,271,294,212,229,233,285e,317,320,322,372,374), schizophrenia(34,35,295), memory problems(212,222), and other more serious neurological diseases such as MS, ALS, Parkinson's, and Alzheimer's(see # 25.).

Calcium plays a major role in the extreme neurotoxicity of mercury and methyl mercury. Both inhibit cellular calcium ATPase and calcium uptake by brain microsomes at very low levels of exposure(270,288,329,333,432,56,). Protein Kinase C (PKC) regulates intracellular and extra cellular singals across neuronal membranes, and both forms of mercury inhibit PKC at micromolar levels, as well as inhibiting phorbal ester binding(43,432). They also block or inhibit calcium L-channel currents in the brain in an irreversable and concecentration dependent manner. Mecury vapor or inorganic mercury exposure affects the posterior cingulate cortex and causes sysregulation with sufficient exposure(428). Some of the resulting conditions include stomatitis, tremor, ADD, erythism, etc. Metallic mercury is much more potent than methyl mercury in such actions, with 50 % inhibitation in animal studies at 13 ppb(333,329).

Mercury causes decreased lithium levels, which is a factor in neurological diseases such as depression and Alzheimer's. Lithium protects brain cells against excess glutamate and calcium, and low levels cause abnormal brain cell balance and neurological disturbances (280,294,333,33,56). Medical texts on neurology (27,295) point out that chronic mercurialism is often not recognized by diagnosticians and misdiagnosed as dementia or neurosis or functional psychosis or just "nerves". "Early manifestations are likely to be subtle and diagnosis difficult: Insomnia, nervousness, mild tremor, impaired judgment and coordination, decreased mental

efficiency, emotional lability, headache, fatigue, loss of sexual drive, depression, etc. are often mistakenly ascribed to psychogenic causes". Very high levels of mercury are found in brain memory areas such as the cerebral cortex and hippocampus of patients with diseases with memory related symptoms (158,34,207,etc.} Mercury interacts with brain tubulin and disassembles microtubiles that maintain neurite structure(207b). Thus chronic exposure to low level mercury vapor can inhibit polymerzation of brain tubulin essential to formation of microtubles. Studies of mercury studies on animals give results similar to that found the the Alzheimer brain.

Animal studies of developmental effects of mercury on the brain have found significant effects at extremely low exposure levels, levels commonly seen in those with amalgam fillings or in dental staff working with amalgam. One study(175) found mercury vapor decreased NGF concentration in rat's forebrain at 4 parts per billion(ppb) tissue concentration. Another study(134) found general toxicity effects at 1 micromole(uM) levels in immature cell cultures, increased immunoreactivity for glial fibrillary protein at 1 nanamole (0.2 ppb) concentration, and microglial response at even lower levels. Other animal studies on rodents and monkeys have found brain cellular migration disturbances, behavioral changes, along with reduced learning and adaption capacity after low levels of mercury vapor exposure (210,264,287,149). The exposure levels in these studies are seen in the fetus and newborn babies of mother's with amalgam fillings or who had work involving amalgam during pregnancy(61).

Epidemiological studies have found that human embryos are also highly susceptible to brain damage from prenatal exposure to mercury. Studies have confirmed that there are vulnerable periods during brain and CNS development that are expecially sensitive to neurotoxic exposures and affect development processes and results(429). The fetal period is most sensitive, but neural developement extends through adolescence. Some conditions found to be related to such toxic exposures include autism, scizophrenia, ADD, dyslexia, eczema, etc. Prenatal/early postnatal exposure to mercury affects level of nerve growth factor(NGF) in the brain and causes brain damage and imbalances in development of the brain (38,119,181, 305,259,210,149,305,24/39,175,255,149). Exposure of developing neuroblastoma cells to sub-cytotoxic doses of mercuric oxide resulted in lower levels of neurofilament proteins than unexposed cells(305). Mercury vapor exposure causes impaired cell proliferation in the brain and organs, resulting in reduced volume for cerebellum and organs and subtle deficiencies(38,305). Exposure to mercury and 4 other heavy metals tested for in a study of school children accounted for 23% of the variation in test scores for reading, spelling and visual motor skills(3). A Canadian study found that blood levels of five metals were able to predict with a 98% accuracy which children were learning disabled(3). Several studies found that mercury causes learning disabilities and impairment, and reduction in IQ(3,21,38,110,264,285c,279). Mercury has an effect on the fetal nervous system at levels far below that considered toxic in adults, and background levels of mercury in mothers correlate significantly with incidence of birth defects and still births (23,38,287,338c,10).

2. Numerous studies have found long term chronic low doses of mercury cause neurological, memory, behavior,sleep, and mood problems(3,34,60,69,70,71,74,107, 108,109,119,140,141,199,212,222,246,255,257, 258,282,290). Neurological effects have been documented at very low levels of exposure(urine Hg< 4 ug/L), levels commonly received by those with amalgam fillings(290). One of the studies at a German University(199) assessed 20,000 people. There is also evidence that fetal or infant exposure causes delayed neurotoxicity evidenced in serious effect at middle age(255,306). Organic tin compounds formed from amalgam are even more neurotoxic than mercury(222,262). Studies of groups of patients with amalgam fillings found significantly more neurological, memory, mood, and behavioral problems than the control groups. (3,34,107,108,109,140,141,199,212,222,290).

A high correlation has been found between patients subjectively diagnosed with CNS & systemic symptoms suggestive of mercury intoxication and immune reactivity to inorganic mercury(MELISA test,118) as well as with MRI positive patients for brain damage. Controls without CNS problems did not have such positive correlations. Mercury,nickel,palladium, and gold induce autoimmunity in genetically predisposed or highly exposed individuals(314,234,130,342). Tests have found a significant portion of people to be in this category and thus more affected by exposure to amalgam than others(see section V).

3. Mercury binds to hemoglobin in the red blood cells thus reducing oxygen carrying capacity(332,35) and adversely affects the vascular response to norepinepherin and potassium. Mercury also increases cytosolic fre calcium levels in lymphocytes in a concentration-dependant manner causing influx from the extracellular medium(270c), and blocks entry of calcium ions into the cytoplasm (1,16,17,21,33,35,333), and at 100 ppb can destroy the membrane of red blood cells(35,22,17,270c) and damage blood vessels- reducing blood supply to the tissues (34,202,306). Amalgam fillings have been found to be related to higher blood pressure, hemoglobin irregularities, tachycardia, chest pains, etc.(201,202,205,212,222,306,310,35). Mercury also interrupts the cytochrome oxidase system, blocking the ATP energy function(35,43,84,232,338c) and impairing astrocyte

function(119).. These effects often result in fatigue and reduced energy levels (35,60,119,140,141, 182,202,212,232,235,313). Mercury also accumulates in the heart and damages myocardial and heart valves (Turpayev,in (35)) & (59,201,205,306,351,370). Both mercury and methyl mercury have been shown to cause depletion of calcium from the heart muscle and to inhibit myosin ATPase activity by 50% at 30 ppb(59), as well as reducing NK-cells in the blood and spleen. The interruption of the ATP energy chemistry results in high levels of porphyrins in the urine(260). Mercury,lead, and other toxics have different patterns of high levels for the 5 types of porphyrins, with pattern indicating likely source and the level extent of damage. The average for those with amalgams is over 3 time that of those without, and is over 20 times normal for some severely poisoned people(232,260). The FDA has approved a test measuring porphyrins as a test for mercury poisoning. However some other dental problems such as nickel crowns, cavitations, and root canals also can cause high porphyrins. Cavitations are diseased areas in bone under teeth or extracted teeth usually caused by lack of adequate blood supply to the area. Tests by special equipment(Cavitat) found cavitations in over 90% of areas under root canals or extracted wisdom teeth that have been tested, and toxins such as anerobic bacteria and other toxics which significantly inhibit body enzymatic processes in virtually all cavitations(437). These toxins have been found to have serious systemic health effects in many cases, and significant health problems to be related such as arthritis, MCS, and CFS. These have been found to be factors along with amalgam in serious chronic conditions such as MS, ALS, Alzheimer's, MCS, CFS, etc.
(35,204,222,292,437). The problem occurs in extractions that are not cleaned out properly after extraction(437).

4. Patch tests for hypersensitivity to mercury have found from 2% to 44% to test positive (87,154,156, 178, 267), much higher for groups with more amalgam fillings and length of exposure than those with less. In studies of medical and dental students, those testing positive had significantly higher average number of amalgam fillings than those not testing positive(and higher levels of mercury in urine(132,156). Of the dental students with 10 or more fillings at least 5 years old, 44% tested allergic. Based on these studies and statistics for the number with 10 or more fillings, the percent of Americans allergic to mercury just from this group would be about 17 million people especially vulnerable to increased immune system reactions to amalgam fillings. However, the total would be much larger and patch tests do not measure the total population getting toxic reactions from mercury. The most sensitive reactions are immune reactions, DNA mutations, developmental,enzyme inhibition, and systemic effects(34,38,61,149,186,226,263,264,270,272,296,305,410-412/357).

5. People with amalgam fillings have an increased number of intestinal microorganisms resistant to mercury and many standard antibiotics. (35,116,117,161,389) Recent studies have found that drug resistant strains of bacteria causing ear infections, sinuitis, and pneumonia moe than doubled since 1996, and similar for strains of bacteria in U.S. rivers(53). Studies have found a significant correlation between mercury resistance and multiple antibiotic resistance (116,117,161,369), and have found that after reducing mercury burden antibiotic resistance declines(251,389,40).

6. Mercury from amalgam binds to the -SH (sulphydryl) groups, resulting in inactivation of sulfur and blocking of enzyme function, producing sulfur metobolites with extreme toxicity that the body is unable to properly detoxify(33,114), along with a defeciency in sulfates required for many body functions. Sulfur is essential in enzymes, hormones, nerve tissue, and red blood cells. These exist in almost every enzymatic process in the body. Blocked or inhibited sulfur oxidation at the cellular level has been found in most with many of the chronic degenertive diseases, including Parkinson's, Alzheimer's, ALS, lupus, rheumatoid arthritis, MCS, autism, etc(330,331,33,56), and appears to be a major factor in these conditions. Mercury also blocks the metabolic action of manganese and the entry of calcium ions into cytoplasm(333). Mercury from amalgam thus has the potential to disturb all metabolic processes(25,21,33, 35,56,60,111,180,194,197}. Mercury is transported throughout the body in blood and can affect cells in the body and organs in different ways.

7. A large study of 20,000 subjects at a German university found a significant relation between the number of amalgam fillings with periodontal problems, neurological problems, and gastrointestinal problems(199). Allergies and hair-loss were found to be 2-3 times as high in a group with large number of amalgam fillings compared to controls(199,9). Levels of mercury in follicular fluid was significantly higher for those with amalgam fillings (9,146). Based on this finding, a Gynecological Clinic that sees a large number of women suffering from alopecia/hair loss that was not responding to treatment had amalgams replaced in 132 women who had not responded to treatment. 68 % of the women then responded to treatment and alopecia was alleviated(187). In other studies involving amalgam removal, the majority had significant improvement (40,317). Higher levels of hormone disturbances, immune disturbances, infertility, and recurrent fungal infections were also found in the amalgam group. The results of hormone tests, cell culture studies, an intervention studies agree(9,146). Other clinics have also found alleviation of hair loss/alopechia after amalgam removal and detox(40,317). Another study in Japan found significantly higher levels of mercury in gray hair than

in dark hair(402).

8. Mercury accumulates in the kidneys with increasing levels over time. One study found levels ranging from 21 to 810 ppb. Mercury exposure has been shown to adversely affect kidney function in occupational and animal studies (20,203,211,260,etc.), and also in those with more than average number of amalgam fillings(254).. Inorganic mercury exposure has been found to exert a dose-dependent cytotoxicity by generating extremely high levels of hydrogen peroxide, which is normally quenched by pyruvate and catalase(203). HgCl2 also has been found to impair function of other organelles such s lysomomes that maintain transmembrane proton gradient, and to decrease glutathione peroxidase activity in the kidneys while upregulating heme oxidase function. The Government's toxic level for mercury in urine is 30 mcg/L (189), but adverse effects have been seen at lower levels and low levels in urine often mean high mercury retention and chronic toxicity problems.

9. Amalgam fillings produce electrical currents which increase mercury vapor release and may have other harmful effects(19,27,28,29,30,35,100,192,194). These currents are measured in micro amps. The central nervous system operates on signals in the range of nano-amps, which is 1000 times less than a micro amp(28). Negatively charged fillings or crown appear to cause higher mercury vapor losses(35). Some studies have also found persons with chronic exposure to electromagnetic fields(EMF) to have higher levels of mercury excretion(28).

10. Mercury from amalgam fillings is transferred to the fetus of pregnant women and children who breast feed at levels often higher than those of the mother(18,19,20,23,31,38,61,112, 186,281). Mercury has an effect on the fetal nervous system at levels far below that considered toxic in adults, and background levels of mercury in mothers correlate significantly with incidence of birth defects and still births(10,23,38,197,210,287,338c,361). Mercury vapor exposure causes impaired cell proliferation in the brain and organs, resulting in reduced volume for cerebellum and organs and subtle deficiencies(38,305).

11. Since mercury(all forms) is documented from studies of humans and animals to be a reproductive and developmental toxin(23,38,61,105,186,224,255,287.305,381,etc.), mercury can reduce reproductive function and cause birth defects and developmental problems in children(2,4,9,10,20,23,24,31,37,38,39,41,55,61,104,146,159, 162,224,255). Clinical evidence indicates that amalgam fillings lead to hormone imbalances that can reduce fertility(9,38,55,4,105,146,367). Mercury has been found to cause decreased sperm volume and motility ,increased sperm abnormalities and spontaneous abortions, increased uterine fibroids/endometritis, and decreased fertility in animals(4,104,105,162) and in humans(9,37,105,146,159,395,433,27,35,38). In studies of women having miscarriages or birth defects, husbands were found to typically have low sperm counts and significantly more visually abnormal sperm(393). Studies indicate an increase in the rate of spontaneous abortions with an increasing concentration of mercury in the fathers' urine before pregnancy(37). Studies have found that mercury accumulates in the ovaries and testes, inhibits enzymes necessary for sperm production, affects DNA in sperm, causes aberrant numbers of chromosomes in cells, causes chromosome breaks, etc.- all of which can cause infertility, spontaneous abortions, or birth defects(35,296). Subfertile males in Hong Kong were found to have 40% more mercury in their hair than fertile controls(55). Studies in monkeys have found decreased sperm motility, abnormal sperm, increased infertility and abortions at low levels of methyl mercury(162,365). Researcher's advise pregnant women should not be exposed to mercury vapor levels above government health standards (2,19,25,227, 61,100,182,282,366); currently U.S. ATSDR mercury health MRL of 0.2 mcg/M3 which is exceeded by any dental work involving amalgam(Section III). Many governments have bans or restrictions on use of amalgam by women of child-bearing age.

12. Mercury causes breaks in DNA (4,38,41,42,197,272,296). Low non-cytotoxic levels of mercury induce dose dependent binding of mercury to DNA and significantly increased cell mutations (142,4) and birth defects(197,38,105).

13. Mercury has been well documented to be an endocrine system disrupting chemical in animals and people, disrupting function of the pituitary gland, hypothallamus, thyroid gland(50,369), enzyme production processes(111,194,33,56), and many hormonal functions at very low levels of exposure (9,105,146, 210, 312,369). The pituitary gland controls many of the body's endocrine system functions and secretes hormones that control most bodily processes, including the immune system and reproductive systems(105,312,381). The hypothallamus regulates body temperature and many metabolic processes. Mercury damage thus commonly results in poor bodily temperature control, in addtion to many problems caused by hormonal imbalances. Such hormonal secretions are affected at levels of mercury exposure much lower than the acute toxicity effects normally tested. Mercury also damages the blood brain barrier and facilitates penetration of the brain by other

toxic metals and substances (311). Low levels of mercuric chloride also inhibit ATPase activity in the thyroid, with methyl mercury inhibiting ATP function at even lower levels(50). Both types of mercury were found to cause denaturing of protein, but inorganic mercury was more potent. These effects result commonly in a reduction in thyroid production(50) and an accumulation in the thyroid of radiation. Toxic metal exposure's adverse influence on thyrocytes can play a major role in thyroid cancer etiology(144) . Among those with chronic immune system problems with related immune antibodies, the types showing the highest level of antibody reductions after amalgam removal include thyreoglobulin and microsomal thyroid antigens(91)

14. There has been no evidence found that there is any safe level of mercury in the body that does not kill cells and harm body processes(WHO,183,189, etc.). This is especially so for the pituitary gland of the developing fetus where mercury has been shown to accumulate and which is the most sensitive to mercury(2-4,19-24,30,31,36-44,61,186).

15. Low levels of mercury and toxic metals have been found to inhibit dihydroteridine reductase, which affects the neural system function by inhibiting transmitters through its effect on phenylalanine, tyrosine and tryptophan transport into neurons(27,98,122,257,289,372,342,372,438). This was found to cause severe impaired amine synthesis and hypokinesis. Tetrahydrobiopterin, which is essential in production of neurotransmitters, is significantly decreased in patients with alzheimer's, Parkinson's, MS, and autism. Such patients have abnormal inhibition of neurotransmitter production. Such symptoms improved for most patients after administration of
R-tetrahydrobiopterin(438), and some after 5-formyltetrahydrofolate, tyrosine(257), and 5-HTP(438).

16. The level of mercury released by amalgam fillings is often more than the levels documented in medical studies to produce adverse effects and above the U.S. government health guidelines for mercury exposure(see previous text).

17. Many studies of patients with major neurological or degenerative diseases have found evidence amalgam fillings may play a major role in development of conditions such as such as Alzheimers (66,67,158,166,204, 207,221,238,242,244,257,295,300), ALS(92,97,325,346,416,423), MS(102,163,170,183,184,212,285,291, 302, 324,326), Parkinson's(98,169,248,250,258,363,56,84),ADD(285e), etc. Mercury exposure causes high levels of oxidative stress/reactive oxygen species(ROS)(13), which has been found to be a major factor in neurological disease(56). Mercury and quinones form conjugates with thiol compounds such as glutathione and cysteine and cause depletion of glutathione, which is necessary to mitigate reactive damage. Such congugates are found to be highest in the brain substantia nigra with similar congugates formed with L-Dopa and dopamine in Parkinson's disease(56). Mercury depletion of GSH and damage to cellular mitochrondria and the increased lipid perxodation in protein and DNA oxidation in the brain appear to be a major factor in Parkinson's disease(33,346). One study found higher than average levels of mercury in the blood, urine, and hair of Parkinson's disease patients(363). Another study(169) found blood and urine mercury levels to be very strongly related to Parkinson's with odds ratios of approx. 20 at high levels of Hg exposure. Increased formation of reactive oxygen species(ROS) has also been found to increase formation of advanced glycation end products(AGEs) that have been found to cause activation of glial cells to produce superoxide and nitric oxide, they can be
considered part of a vicious cycle, which finally leads to neuronal cell death in the
substantia nigra in PD(424). Another study (145) that reveiwed occupational exposure data found that occupational exposure to manganese and copper have high odds rations for relation to PD, as well as multiple exposures to these and lead, but noted that this effect was only seen for exposure of over 20 years.

Mercury has been found to accumulate preferentially in the primary motor function related areas such as the brain stem, cerebellum, rhombencephalon, dorsal root ganglia, and anterior horn motor neurons, which enervate the skeletal muscles(48,291,327,329). There is considerable indication this may be a factor in ALS development (48,325,405,416,423). Mercury penetrates and damages the blood brain barrier allowing penetration of the barrier by other substances that are neurotoxic (20,38,85,105,162,301,311/262). Such damage to the blood brain barrier's function has been found to be a major factor in chronic neurological diseases such as MS(286,289,291,302, 324,326). MS patients have been found to have much higher levels of mercury in cerebrospinal fluid compared to controls (163,35,139). Large German studies including studies at German universities have found that MS patients usually have high levels of mercury body burden, with one study finding 300% higher than controls(271). Most recovered after mercury detox, with some requiring addtional treatment for viruses and intestinal dysbiosis. Studies have found mercury related mental effects to be indistinguishable from those of MS (207,212,222,244,271,289,291,302,183,184,324,326).

Low levels of toxic metals have been found to inhibit dihydroteridine reductase, which affects the neural system function by inhibiting brain transmitters through its effect on phenylalanine, tyrosine and tryptophan

transport into neurons(122,257,289,372). This was found to cause severe impaired amine synthesis and hypokinesis. Tetrahydro-biopterin, which is essential in production of nerurotransmitters, is significantly decreased in patients with Alzheimer's's, Parkinson's, and MS. Such patients have abnormal inhibition of neurotransmitter production.(supplements which inhibit breach of the blood brain barrier such as bioflavonoids have been found to slow such neurological damage).

Clinical tests of patients with MND,ALS, Parkinson's, Alzheimer's, Lupus(SLE), rheumatoid arthritis and autsism have found that the patients generally have elevated plasma cysteine to sulphate ratios, with the average being 500%higher than controls(330,331,56,33e), and in general being poor sulphur oxidizers. This means that these patients have insufficient sulfates available to carry out necessary bodily processes. Mercury has been shown to diminish and block sulphur oxidation and thus reducing glutathione levels which is the part of this process involved in detoxifying and excretion of toxics like mercury(33). Glutathion is produced through the sulphur oxidation side of this process. Low levels of available glutathione have been shown to increase mercury retention and increase toxic effects(111), while high levels of free cysteine have been demonstrated to make toxicity due to inorganic mercury more severe(333,194,56,33e). Mercury has also been found to play a part in inducing intolerance and neuronal problems through blockage of the P-450 enzymatic process(84,33e).

18. Mercury at extremely low levels also interferes with formation of tubulin producing neurofibrillary tangles in the brain similar to those observed in Alzheimers patients, with high levels of mercury in the brain (207), and low levels of zinc(363,43). Mercury and the induced neurofibrillary tangles also appear to produce a functional zinc deficiency in the of AD sufferers(242),as well as causing reduced lithium levels which is another factor in such diseases. Lithium protects brain cells against excess glutamate induced excitability and calcium influx(280,56). Also mercury binds with cell membranes interfering with sodium and potassium enzyme functions, causing excess membrane permeability, especially in terms of the blood-brain barrier (155,207,311). Less than 1ppm mercury in the blood stream can impair the blood- brain barrier. Mercury was also found to accumulate in the mitochondria and interfere with their vital functions, and to inhibit cytochrome C enzymes which affect energy supply to the brain(43,84,232,338c,35). Persons with the Apo-E4 gene form of apolipoprotein E which transports cholesterol in the blood, are especially susceptible to this damage(207,221,346), while those with Apo-E2 which has extra cysteine and is a better mercury scavanger have less damage. The majority have an intermediate form Apo-E3. This appears to be a factor in susceptablity to Alzheimer's disease, Parkinson's disease and multiple schlerosis. Ones susceptability can be estimated by testing for this condition. In many cases (many thousand documented)removal of amalgam fillings and treatment for metal toxicity led to "cure' or significant improvement in health(see Section V). There is some evidence that some forms of leukemia are abnormal response to antigenic stimulation by mercury or other such toxics and removal of amalgam has led to remission in some cases(35,38,180,239).

19. Mercury and methyl mercury impair or inhibit all cell functions and deplete calcium stores(96). This can be a major factor in bone loss of calcium(osteoperosis).

VI. Results of Removal of Amalgam Fillings

1. For the week following amalgam removal, body mercury levels increase significantly, depending on protective measures taken, but within 2 weeks levels fall significantly.(82,89) Chronic conditions can worsen temporarily, but usually improve if adequate precautions are taken to reduce exposure during removal.

2. Removal of amalgam fillings resulted in a significant reduction in body burden and body waste product load of mercury(75,82,88,89,93,95,115).

3. Total reduction in mercury levels in blood and urine is often over 80% within a few months(79,82,89,93,115,57).

4. There are extensive documented cases (many thousands) where removal of amalgam fillings led to cure or significant improvement of serious health problems such as periodontal diseases(40,46,57,60,75,78,82,86,87,90, 94,95,100,101,115,133,168,212,222,233,271,313,317,321,322,376), oral keratosis(pre cancer)(87,251), immune system/autoimmune problems (8,222,270,271,313,323,368,91,212,229,291,35,etc.), allergies(8,26,40,46,94, 95,97,165,212,222,228,229,233,271,317,322,349,376), asthma(8,75,97,222,228,271,322), chronic headaches/ migraines(5,34,95,212 222,229,233,271,317,322,349,354,115,376,440), multiple chemical sensitivities (26,95,222, 229,232,233, 35,115,313,368), epilepsy (5,309,229), blood conditions(212,222,232,233,271, 35,95), eczema (60,212,222, 271,313,317,323,94,376,341), chron's disease(222,229), stomach problems (95,212,222,228,229, 233,271,317, 322,440,35), lupus(12,113,222, 229,233),

dizzyness/vertigo(40,95,212,222,271,322,376), arthritis(95,103,212, 222,271,313,322,358), MS(94,95,102,170,212,222,271,291,302,34,35,229), ALS(97,229,423,405,35), Parkinson's/ muscle tremor(222,248,229,271,212,94,98,35), Alzheimer's(204), muscular/joint pain/fibromyalgia (222,293,317,322,369,440, 94), infertility(9,38,229,367), depression (94,107,222,271,294,212,229,233,285e,317,322,376,40), schizohprenia (294,34,35), insomnia(94,212, 222,271, 317,322,376), anger(212,233,102), anxiety & mental confusion (94,212,222,229,233,271,317,322,440,57), susceptability to infections (40,222,251,317,349, 350), antibiotic resistant infection(251), endometriosis(229,38), Chronic Fatigue Syndrome (8,60,212,293,229,222, 232,233,271,313,317, 368,369,376,440), tachycardia and heart problems (205,59,94,115,212,222,232,233, 271,306,310,212), memory disorders(94,222,440),cancer/ leukemia(35,38,94,180), neuropathy/paresthesia (94,212,222,322), vision disturbances(212,271,322), alopecia/hair loss (40,187,271,317,322,349),sinus problems (40,94,222,271,322), tinnitus(94,222,271,349,376), inflamation of eye(222,271,322), psoriasis(385,375,408), skin conditions(212,222), urinary/prostrate problems(212,222), hearing loss(102), candida(26,404),etc., or in significant improvement in symptoms (35,38,40,57,78,86-91,93-103,115,148, 165,168,170,180,182,185,199,204, 212,222,229,233, 234, 235,246, 271,282,289,312,317,321,322,323,376). The above over 60,000 cases of cure or significant improvements were not isolated cases of cures; the clinical studies indicated a large majority of most such type cases treated showed significant improvement. Details available and case histories. Some of the above cases used chemical or natural chelation to reduce accumulated mercury body burden in addtion to amalgam replacement. Some clinics using DMPS for chelation reported over 80% with chronic health problems were cured or significantly improved(222,271, 359). Other clinics reported similar success. But the recovery rate of those using dentists with special equipment and training in protecting the patient reported much higher succes rates than those with standard training and equipment, 97% versis 37 to 88%(435).

Clinical studies have found that patch testing is not a good predictor of success of amalgam remvoal, as a high percentage of those testing negative also recovered from chronic conditions after rplacement of fillings(86,87,168,etc.).

In a large German study of MS patients after amalgam revision, extraction resulted in 85% recovery rate versis only 16% for filling replacement alone (222,302). Other cases have found that recovery from serious autoimmune diseases, dementia, or cancer may require more agressive mercury removal techniques than simple filling replacement due to body burden. This appears to be due to migration of mercury into roots & gums that is not eliminated by simple filling replacement. That such mercury(and simiarly bacteria) in the teeth and gums have direct routes to the brain and CNS has been documented by several medical studies(34,325,etc.).

Among those with chronic immune system problems with related immune antibodies, the types showing the highest level of antibody reductions after amalgam removal include glomerular basal membrane, thyreeoglobulin, and microsomal thyroid antigens(91)

Swedish researchers have developed a sophisticated test for immune/autoimmune reactions that has proved sucessful in diagnosing and treating environmetally caused diseases such as lichen planus, MS, etc. related to mercury and other immunotoxics(60,313).

Interviews of a large population of Swedish patients that had amalgams removed due to health problems found that virtually all reported significant health improvements and that the health improvements were permanent(233). (study period 17 years) A compilation of an even larger population found similar results(212,282). For example 89% of those reporting allergies had significant improvements or total elimination; extrapolated to U.S. population this would represent over 17 million people who would benefit regarding allergies alone.

VII. Health Effects from Dental Personnel Exposure to Mercury Vapor

1. It is well documented that dentists and dental personnel who work with amalgam are chronically exposed to mercury vapor, which accumulates in their bodies to much higher levels than for most non-occupationally exposed. Adverse health effects of this exposure including subtle neurological effects have also been well documented that affect most dentists and dental assistants, with measurable effects among those in the lowest levels of exposure. Mercury levels of dental personnel average at least 2 times that of controls for hair(397-401), urine(57,64,69,99,123,124,138,171,173,222,249,290,362,397-399) and for blood (124,195,253,249,397). Sweden, which has banned use of mercury in fillings, is the country with the most exposure and health effects studies regarding amalgam, and urine levels in dental professionals from Swedish and European studies ranged from 0.8 to 30.1 ug/L with study averages from 3.7 to 6.2 ug/L (124,172,253,64,68). The Swedish safety guideline for mercury in urine is 5.6 nmol Hg/mmol(11.6 ug/L). Study averages for other countries ranged from 3.3 to 36 microgram/liter(ug/L)(69,70,171,290,397). A large survey of dentists at the Norwegian Dental Assoc. meeting(171) found that the mean mercury level in 1986 was 7.8 ug/L with approx. 16% above 13.6ug/L,

and for 1987 found an average of 8.6 ug/L with approx. 15% above 15.8 ug/L, with women having higher levels than men in general. A U.S. national sample of dentists provided by the American Dental Association had an average of 5.2 ug/L (70,290). In that large sample of dentists, 10% of dentists had urine mercury levels over 10.4 ug/L and 1% had levels over 33.4ug/L(290), indicating daily exposure levels of over 100 ug/day. Mercury excretion levels were found to have a positive correlation with the number of amalgams placed or replaced per week, the number of amalgams polished each week, and with the number of fillings in the dentist(171,172,173). In one study, each filling was found to increase mercury in the urine approx. 3%, though the relationship was nonlinear and increased more with larger number of fillings(124). Much higher accumulated body burden levels in dental personnel were found based on challenge tests than for controls(303), with excretion levels after a dose of a chelator as high as 10 times the corresponding levels for controls(57,69,290,303). Autopsy studies have found similar high body accumulation in dental workers, with levels in pituitary gland and thyroid over 10 times controls and levels in renal cortex 7 times controls(99,363,38). Autopsies of former dental staff found levels of mercury in the pituitary gland averaged as high as 4,040 ppb. They also found much higher levels in the brain occipital cortex(as high as 300 ppb), renal cortex(as high as 2110 ppb) and thyroid(as high as 28,000 ppb. In general dental assistants and women dental workers showed higher levels of mercury than male dentists (171,172,173,253,303,362).

Mercury levels in blood of dental professionals ranged from 0.6 to 57 ug/L, with study averages ranging from 1.34 to 9.8 ug/L (124,195,253,249). A review of several studies of mercury level in hair or nails of dentists and dental workers found median levels were 50 to 300% more than those of controls(38, p287-288,& 10,16,178). A group of dental students taking a course involving work with amalgam had their urine tested before and after the course was over. The average urine level increased by 500% during the course(63). Allergy tests given to another group of dental students found 44% of them were allergic to mercury(156). Studies have found that the longer time exposed, the more likely to be allergic. Another group of dental students had similar results(362), while another group of dental student showed comprimized immune systems compared to medical students. The total lympocyte count, total T cell numbers(CD3), T helper/ inducer(CD4+CD8-), and T suppressor/cytotoxic(CD4-CD8+) numbers were singinficantly elevated in the dental students compared to the matched control group(407). Similar results have been seen in other studies as well(407).

Urinary porphyrin profiles were found to be an excellent biomarker of level of body mercury level and mercury damage neurological effects, with coprorphyrin significantly higher in those with higher mercury exposure and urine levels(70,260). Coproporphyrin levels have a higher correlation with symptoms and body mercury levels as tested by challenge test(69,303), but care should be taken regarding challenge tests as the high levels of mercury released can cause serious health effects in some, especially those who still have amalgam fillings or high accumulations of mercury. Screening test that are less burdensome and less expensive are now available as first morning void urine samples have been found to be highly correlations to 24 hour urine test for mercury level or porphyrins(73).

2. The average dental office exposure affects the body mercury level at least as much as the workers on fillings(57,64,69,123,138,171,173,303), with several studies finding levels approximately the same as having 19 amalgam fillings(123,124,173). Many surveys have been made of office exposure levels(1,6,7,10, etc.) The level of mercury at breathing point in offices measured ranged form 0.7 to over 300 micrograms per cubic meter(ug/M3) (120,172,253,249). The average levels in offices with reasonable controls ranged from 1.5 to 3.6 ug/M3, but even in Sweden which has had more office environmental controls than others spot levels of over 150 ug/M3 were found in 8 offices(172). Another study found spot readings as high as 200 ug/M3 in offices with few controls that only used saliva extractor(120). OSHA surveys find 6-16% of U.S. dental offices exceed the OSHA dental office standard of 50 ug/M3. The U.S. ATSDR mercury vapor exposure MRL for chronic exposure is much lower, 0.2 ug/M3 (217) (giving approx. 4 ug/day exposure), similar to U.S. EPA and Health Canada guidelines(2,209). Thus most office mercury levels were found to far exceed the U.S. guidelines for chronic mercury exposure.

Use of high speed drill in removal or replacement has been found to create high volume of mercury vapor and respirable particles, and dental masks to only filter out about 40 % of such particles(219,247). This produces high levels of exposure to patient and dental staff. Use of water spray, high velocity evacuation and rubber dam reduce exposure to patient and dental staff significantly, as seen in previous discussion. In addition to these measures researchers also advise all dental staff should wear face masks and patients be supplied with outside air(120,153). Some studies note that carpeting in dental offices should be avoided as it is a major repository of mercury(188,7)

Use of such measures along with a Clean-Up™ aspirator tip was found to reduce exposure to patient and staff approximately 90%(397).

3. Dentists were found to score significantly worse than a comparable control group on neurobehavioral tests of motor speed, visual scanning,and visuomotor coordination(69,70,123,249,290,395), concentration ,

verbal memory, visual memory(68,69,70,249,290,395), and emotional/mood tests(70,249,290,395). Test performance was found to be proportional to exposure/body levels of mercury(68,70,249,290,395). Significant adverse neurobehavioral effects were found even for dental personnel receiving low exposure levels(less than 4 ug/l Hg in urine)(290). This study was for dental personnel having mercury excretion levels below the 10th percentile of the overall dental population. Such levels are also common among the general population of non- dental personnel with several fillings. This study used a new methodology which used standard urine mercury levels as a measure of recent exposure, and urine levels after chelation with a chemical, DMPS, to measure body burden mercury levels. Chelators like DMPS have been found after a fast to release mercury from cells in tissue to be available for excretion. This method was found to give enhanced precision and power to the results of the tests and correlations. Even at the low levels of exposure of the subjects of this study, there were clear demonstrated differences in test scores involving memory, mood, and motor skills related to the level of exposure pre and post chelation(290). Those with higher levels of mercury had deficits in both memory, mood, and motor function compared to those with lower exposure levels. And the plotted test results gave no indication of there existing a theshhold below effects were not measurable. Mood scores including anger were found to correlate more strongly with pre chelation urine mercury levels; while toxicity symptoms, concentration, memory(vocabulary,word), and motor function correlated more strongly with post-chelation mercury levels.

Several dentists have been documented to suffer from mercury poisoning(72,74,193,246,247,248,369), other than the documented neurological effects. One of the common effects of chronic mercury exposure is chronic fatigue due to immune system overload and activation. Many studies have found this occurs frequently in dentists and dental staff along with other related symtoms- lack of ability to concentrate, chronic muscular pain, burnout, etc.(249,369.377.378). In a group of dentists and dental workers suffering from extreme fatigue and tested by the immune test MELISA, 50% had autoimmune reaction to inorganic mercury and immune reactions to other metals used in dentistry were also common(369). Tests of controls did not find such immune reactions common.

One dentist with severe symptoms similar to ALS improved after treatment for mercury poisoning(246), and another with Parkinson's disease recovered after reduction of exposure and chelation(248). Similar cases among those with other occupational exposure have been seen. A survey of over 60,000 U.S. dentists and dental assistants with chronic exposure to mercury vapor and anesthetics found increased health problems compared to controls, including significantly higher liver, kidney, and neurological diseases(99,193). Other studies reviewed found increased rates of brain cancer and allergies(99,193). Swedish male dentists were found to have an elevated standardized mortality ratio compared to other male academic groups(284). Dental workers and other workers exposed to mercury vapor were found to have a shortening of visual evoked potential latency and a decrease in amplitude, with magnitudes correlated with urine excretion levels(190). Dentists were also found to have a high incidence of radicular muscular neuralgia and peripheral sensory degradation(190,395).

4. Both dental hygienists and patients get high doses of mercury vapor when dental hygienists polish or use ultrasonic scalers on amalgam surfaces(240,400). Pregnant women or pregnant hygienist especially should avoid these practices during pregnancy or while nursing since maternal mercury exposure has been shown to affect the fetus and to be related to birth defects, SIDS, etc.(23,37,38,110,142,146,401,19,31). Amalgam has been shown to be the main source of mercury in most infants and breast milk, which often contain higher mercury levels than in the mother's blood (20,61,112,186,287). Because of high documented exposure levels when amalgam fillings are brushed(182,222,348) dental hygienist are advised not to polish dental amalgams when cleaning teeth. Face masks worn by dental workers filter out only about 40% of small dislodged amalgam particles from drilling or polishing, and very little mercury vapor(247). Dental staff have been found to have significantly higher prevalence of eye problems, conjunctivitis, atopic dermatitis, and contact urticaria(247,156,74).

An epidemiological survey conducted in Lithuania on women working in dental offices(where Hg concentrations were < 80 ug/M3) had increased incidence of spontaneous abortions and breast pathologies that were directly related to the length of time on the job(277a). A large U.S. survey also found higher spontaneous abortion rate among dental assistants and wives of dentists(193), and another study found an increased risk of spontaneous abortions and other pregnancy complications among women working in dental surguries(277b). A study of dentist and dental assistants in the Netherlands found 50% higher rates of spontaneous abortions, stillbirths, and congenital defects than for the control group(394), with unusually high occurance of spina bifida. A study in Poland also found a significant positive association between mercury levels and occurrence of reproductive failures and menstrual cycle disorders, and concluded dental work to be an occupational hazard with respect to reproductive processes(401).

5. Body burden increases with time and older dentists have median mercury urine levels about 4 times those of controls, as well as higher brain and body burdens(1,34, 68-74,99), and poor performance on memory tests(68, 69,70,249,290) Some older dentists have mercury levels in some parts of the brain as much as 80 times higher

than normal levels(14,34,99). Dentists and dental personnel experience significantly higher levels of neurological, memory, musculoskeletal, visiomotor, mood, and behavioral problems, which increase with years of exposure (1,34,68-73,88,123,188,246,247,248,249,290,369,395). Even dental personnel with relatively low exposure(urine Hg<4 ug/l) were found to have significant neurological effects(290) and was found to be correlated with body burden of mercury. Most studies find dentists have increased levels of irritability and tension(1), high rates of drug dependancy and disability due to psychological problems(15), and higher suicide rates than the general white population (284), but one study found rates in same range as doctors.

6. Female dental technicians who work with amalgam tend to have increased menstrual disturbances (275,401,10,38), significantly reduced fertility and lowered probability of conception (10,24,38,121), increased spontaneous abortions (10,38,277,433), and their children have significantly lower average IQ compared to the general population (1,279,38,110). Populations with only slightly increased levels of mercury in hair had decreases in academic ability(3). Effects are directly related to length of time on the job(277). The level of mercury excreted in urine is significantly higher for female dental assistants than dentists due to biological factors (171,172, 173,247). Several dental assistants have been diagnosed with mercury toxicity and some have died of related health effects(32,245,246,247,248). From the medical register of births since 1967 in Norway, it can be seen that dental nurse/assistants have a clearly increased risk of having a deformed child or spontaneous abortion(433). Female dentists have increased rates of spontaneous abortion and perinatal mortality(193,38,10,433)),compared to controls. A study in Poland found a much higher incidence of birth defects among female dentist and dental assistants than normal(10). A chronically ill dental nurse diagnosed with mercury sensitivity recovered after replacement of fillings and changing jobs(60), and a female dentist recovered from Parkinson's after mercury detox(248). Some studies have found increased risk of lung, kidney, brain, and CNS system cancers among dental workers(14,34,99,143,283).

7. Many homes of dentists have been found to have high levels of mercury contamination used by dentists bringing mercury home on shoes and clothes(188).

VIII. Scientists and Government Panels or Bodies That Have Found Amalgam Fillings to be Unsafe.

1. A World Health Organization Scientific Panel concluded that there is no safe level of mercury exposure(183,189,208). The Chairman of the panel, Lars Friberg stated that "dental amalgam is not safe for everyone to use(208,238). A study of dental personnel having very low levels of mercury excretion found measurable neurological effects including memory, mood, and motor function related to mercury exposure level as measured by excretion levels(290). and found no threshhold level below which effects were not measurable.. Other studies have found measurable effects to the immune, cardiovascular, hormonal, and reproductive systems from common levels of exposure(Section IV). Studies have found significant measurable adverse health effects at levels far below current government regulatory levels for mercury(290).

2. In 1987 the Federal Dept. of Health in Germany issued an advisory warning against use of dental amalgam in pregnant women(61). Most major countries other than the U.S. have similar or more extensive bans or health warnings regarding the use of amalgam, including Canada, Great Britain, France, Austria, Norway, Sweden, Japan, Australia, New Zealand, etc.(164,435) A Swedish National Mercury Amalgam Review Panel and a similar Norwegian panel found that "from a toxicological point of view, mercury is too toxic to use as a filling material"(164,435). Both countries have indicated plans to ban or phase out use of amalgam. A major amalgam manufacturer, Caulk Inc., advises that amalgam should not be used as a base for crowns or for retrograde root fillings as is commonly done in some coutries(387). A Swedish medical panel unanimously recommended to the government "discontinuing the use of amalgam as a dental material"(282). The U.S. EPA found that removed amalgam fillings are hazardous and must be sealed airtight and exposed of as hazardous waste(214). Most European countries require controls on dental waste amalgam emissions to sewers or air. A Canadian Government study for Health Canada concluded that any person with any number of amalgam fillings receives exposure beyond that recommended by the USPHS Standard(209). Many of those researching amalgam related health effects including several very prominent scientists have concluded that the health effects are widespread and serious so that mercury should not be used as a filling material (1,18,19,20, 36,38,57,60,61,88,94,99,125,148, 153,164,170,183,208, 209,210,212,222, 227,236, 238,282).

3. The use of mercury amalgams has been banned for children and women of child-bearing age or put on a schedule for phase out by several European countries. The use of amalgam is declining in Europe and Germany's largest producer of amalgam has ceased production, The director of the U.S. Federal program overseeing dental safety advises against using mercury amalgam for new fillings.

Facts about Mercury and Dental Amalgam
(with Medical Study References)

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Dr. Vasken Aposhian, Dept. Head, Molecular and Cellular Biology, Univ. Of Arizona; Dr. David Eggleston, Univ. Of Califoria, researcher on mercury in the brain; Dr. Boyd Haley, Univ. Of Kentucky reasearcher on mercury in the brain and Alzheimer's Disease (http://www.altcorp.com/); Dr. Gustav Drasch, Univ. Of Munich, reaearcher on mercury in brains of dead infants and fetuses; Dr. D. Echeverria, Neuro-Toxicologist, researcher on reproductive problems and birth defects in dental

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