DECLARATION OF FRITZ L. LORSCHEIDER, Ph.D.

I, FRITZ L. LORSCHEIDER, hereby declare:

1. I am a Professor Emeritus in the Department of Physiology & Biophysics at the University of Calgary Faculty of Medicine, in Canada. I received my Ph.D. in Physiology from Michigan State University in 1970. My experience as a principal research investigator spans 32 years in academic medicine. I have co-authored more than 90 major research papers that have been published in peer-adjudicated medical science journals, and have also authored more than 100 other scientific communications. Since 1985, a number of my papers have focused on the metabolism, toxicology, and pathophysiology of mercury, with specific reference to its release from dental amalgam fillings. These papers have employed human clinical studies along with animal studies in monkey, sheep, and rat experimental models, and cell culture systems. Professional society memberships which I hold include the American Physiological Society, and the American Society for Biochemistry and Molecular Biology. Awards which I have received include, a National Institutes of Health ("NIH") Postdoctoral Fellowship (1969-70), and the Rayne Memorial Lectureship, University of Oxford (May, 1999). Attached hereto as Exhibit "A," is a true and correct copy of my Curriculum Vitae.

2. In evaluating the developed toxicologic data relevant to animal and human studies to mercury, exposure to mercury from amalgam fillings, the target organs of such exposures, and other relevant issues herein, I have conducted literature searches on various computerized databases; evaluated published literature on primary studies[1]; published invited review articles,[2] and held working meetings with experts in the field. I have also conducted and published numerous experiments in our laboratory[3] in the University of Calgary. In addition, I have reviewed evaluations and conclusions of various governmental agencies, including, the World

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[1]*See e.g.*, Lorscheider, F.L., Vimy, M.J. and Summers, A.O. *Mercury Exposure from Silver Tooth Fillings: Emerging Evidence Questions a Traditional Dental Paradigm* FASEB J. 9, 504-508, 1995.

[2]*See e.g., id.*

[3]*See e.g., id.*

Health Organization ("WHO"), the National Institute of Health ("NIH"), the United States Environmental Protection Agency ("EPA"), and other groups regarding this issue.[4]

3. Mercury is one of the most toxic, nonradioactive elements known to man. Virtually every industry has either reduced or banned the use of mercury with the exception of dentistry. Dental amalgam is approximately 50% mercury by weight. *Each* amalgam typically has between 700 milligrams to a gram of mercury. A typical person having between 5 and 15 amalgams, would have as much as 15 grams of mercury implanted in his or her mouth. This amount is significant using any standard. I am aware of no other situation today where grams of mercury are implanted in any human being. In fact, in the healthcare industry, mercury has been all but banned.

4. The ADA's position that "no valid scientific evidence exists that dental amalgam poses any health risk – other than rare, localized allergic reactions," is indefensible, and as far as I understand, is the basis for its ethical rule prohibiting disclosure of amalgam toxicity to patients. A plethora of peer reviewed, published, scientific studies and articles completely refute this point. Frankly, outside of the Journal of the American Dental Association or JADA, the ADA's trade journal, which *is not* a refereed scientific journal, but solely a *trade* journal, scientific consensus is completely contrary to the ADA's position. The fact is that are no solid, refereed publications showing that mercury is not emitted from dental amalgams. Any ethical rule that prohibits a practitioner from disclosing the potential toxicity of amalgam to a patient based on the scientific evidence would simply deprive patients of vital health warnings and information regarding mercury amalgams.

5. Dental Amalgam emits dangerous levels of mercury. In fact, according to a 1991 WHO report and a subsequent clinical experimental study, dental amalgam constitutes *the major* human exposure to mercury.[5] *Grams* of mercury are in the mouths of individuals with several

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[4]*See e.g.*, Lorscheider, F.L. Vimy, M.J. *Evaluation of the Safety Issue of Mercury Release from Dental Fillings*, FASEB J. 7, 1432-1433, 1993.

[5]*See also*, Aposhian, H.V., Bruce D.C., Alter, W., Dart, R.C., Hurlbut, K.M., Aposhian, M.M. *Urinary Mercury after administration of DMPS; correlation with dental amalgam score*,

amalgam fillings. Also, the level of blood and urine mercury positively correlates with the number of amalgam fillings.[6]

6. Careful evaluation of the amount of mercury emitted from a commonly used dental amalgam in a test tube with 10 ml of water was presented in an article entitled "Long-term Dissolution of Mercury from a Non-Mercury-Releasing Amalgam."[7] This study showed that "the over-all mean release of mercury was 43.5 ± 3.2 micrograms per cm^2/day, and the amount remained fairly constant during the duration of the experiments (2 years)." This was without pressure, heat or galvanism as would have occurred if the amalgams were in a human mouth.

7. Furthermore, due to the substantial amounts of mercury in amalgams, it is the number of amalgams that controls the amount of mercury exposure, more so than the length of time each amalgam is in the mouth.[8] Put another way, since each amalgam contains between 700,000 to 1,000,000 micrograms of mercury, and mercury is released at a rate of approximately 15 micrograms per day from each amalgam,[9] it would take 128 years before a typical amalgam is completely depleted of its mercury content. There is a wide variance which is influenced by the surface area of the amalgam, its copper content, the individual's eating and grinding habits, and rate of acidity, as noted herein. However, even at very conservative estimates, these figures equate to a substantial amount of *chronic* (continuous, daily) mercury exposure over a sustained,

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FASEB J., 6:2472-2476, 1992.

See also, Lorscheider, F.L., Vimy, M.J. and Summers, A.O. *Mercury Exposure from Silver Tooth Fillings: Emerging Evidence Questions a Traditional Dental Paradigm* FASEB J. 9, 504-508, 1995.

[6]*See e.g.*, Kingman, A., Albertini, T. and Brown, L.J. Mercury Concentrations in Urine and Whole-Blood Associated with Amalgam Exposure in a U.S. Military Population. J. Dental Research 77(3) 461-71, 1998.

[7]Chew, C. L., Soh, G., Lee, A. S. and Yeoh, T. S. Long-term Dissolution of Mercury from a Non-Mercury-Releasing Amalgam. Clinical Preventive Dentistry 13(3): 5-7, May-June (1991).

[8]*See e.g.*, Motorkina AV, Barer Gm, Volozhin AL, *Patterns of mercury release from amalgam fillings into the oral cavity*, Stomatologiia (Mosk) 1997; 76(4) 9-11.

[9]Gross M.J., Harrison, J.A. *Some electrochemical features of the in vivo corrosion of dental amalgams* J. Appl. Eletrochem. 19, 301-310, 1989.

prolonged period of time.

8. Mercury from amalgams is readily taken up by the human body and distributed to various organs. Very little, if any, of the mercury vapors are exhaled, in part due to the fact that the mercury vapors are lipophilic (or hydrophobic; water-repellant); the vapors as well as mercury particles are absorbed into the lungs and body tissues. Through the lungs, for instance, mercury enters the bloodstream where it has access to all of the major organs; of particular concern are the kidneys and the central nervous system.[10] For example, studies have been performed where amalgams containing radioactive mercury were placed in sheep and monkeys, showed the radioactivity collecting in most body tissues.[11] Human studies confirm these findings.[12]

9. Traditionally, two basic assumptions were made about amalgam mercury which formed the basis for claiming that they were safe; both are false and multiple studies have so demonstrated. In fact, simple chemistry disproves both. The assumptions are: (1) that amalgam mercury is chemically bound; and (2) that amalgam mercury is biologically inactive. These were used to support the theory that amalgams *do not* emit mercury, and as such are safe. Obviously, based on numerous studies, we now know that amalgams do emit mercury. However, even

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[10]*See e.g.*, Reinhardt JW, *Side-effects: mercury contribution to body burden from dental amalgam*, Adv Dent Res 1992 Sep; 6:110-3.

[11]*See e.g.*, Lorscheider, F.L., Vimy, M.J. and Summers, A.O. *Mercury Exposure from Silver Tooth Fillings: Emerging Evidence Questions a Traditional Dental Paradigm* FASEB J. 9, 504-508, 1995.

[12]*See e.g.*, Nylander, M., Friberg, L. and Lind, B. *Mercury Concentrations in the Human Brain and Kidneys in Relation to Exposure from Dental Amalgam Fillings*. Swedish Dentistry J. 11:179-187, 1987;

see also, Nylander, M., Friberg, L., Eggleston, D., Bjorkman, L. *Mercury Accumulation in Tissues from Dental Staff and Controls in Relation to Exposure.* Swedish Dental J. 13, 235-243, 1989;

see also, Zander D, Ewers U, Freier I, Brockhaus A., *The mercury exposure of the population. III. Mercury mobilisation by DMPS (Dimaval) in subjects with and without amalgam fillings*, Zentralbl Hyg Umweltmed, 1992 Feb; 192(5): 447-54.

See also, Aposhian, et al., *supra*, FASEB J. 6: 2472-2476, 1992.

without the studies, it is easy to see that neither one of these assumptions can be true.

10. First, by definition, an amalgam is a mixture that does not involve a chemical co-valent bonding reaction. Furthermore, in the case of amalgam, all of the elements that are used to form amalgam have filled electron shells. As such, there does not exist a covalent bond among them. This means that unlike chemically bound molecules, the elements that are mixed as an emulsion in an amalgam do not lose any of their original properties. Simply put, mercury does not lose any of its toxicity because it is inside of dental amalgam. As shown in study after study, mercury is emitted from amalgams at substantial and toxic amounts, and is then distributed within the human body.

11. As to the second misnomer, amalgam mercury is *not* biologically inactive. As noted in numerous studies, some of which are cited herein, mercury emits from amalgams on a 24 hour a day basis.[13] The emissions are increased based on the introduction of hot substances, such as beverages (coffee and the sort), and with chewing (such as chewing gum or food).[14] Additionally, numerous factors cause abrasion of the amalgams, again causing an increase in emissions. This includes the grinding of teeth. Once the mercury is emitted, it is carried to various organs, including, but not limited to, the brain as supported by various studies, some of which are cited herein. Based on this, amalgams cannot be said to be biologically inactive. In fact, there is consensus within the scientific community that amalgams emit mercury, and that the mercury is absorbed into the human body. The current debate is over the degree to which this mercury exposure is toxic.

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[13]*See e.g.*, Lorscheider, et al., *supra*, FASEB J. 9, 504-508, 1995.

[14]*See e.g.*, Bjorkman, L., Lind, B., *Factors influencing mercury evaporation rate from dental amalgam fillings* Dept. of Env. Hyg., Karolinska Institutet, Stockholm, Sweden, Scand J Dent Res; 100 (6): 354-60, 1992;

Sallsten G., Thoren J., Barregard L., Schutz A., Skarping G., *Long-term use of nicotine chewing gum and mercury exposure from dental amalgam fillings* Dept. of Occupational Med., Sahlgrenska University Hospital, Goteborg, Sweden; J Dent Res; 75 (1): 594-8, 1996 Jan;

Takahashi, Y., Tsuruta, S., Hasegawa, J., Kameyama, Y., Yoshida, M., *Release of mercury from dental amalgam fillings in pregnant rats and distribution of mercury in maternal and fetal tissues*, Toxicology 2001 Jun 21; 163 (2-3): 115-26 (showing that chewing increased mercury in oral air samples by as much as 20-fold).

12. Mercury emitting from a dental amalgam can be easily detected using the same mercury vapor analysis instrument used by OSHA and the EPA to monitor mercury levels. It is important to note that measurement of mercury emissions by a mercury vapor analyzer in the human mouth tends to *greatly underestimate* the amount of mercury exiting the amalgam as it does not measure much of the mercury that is rapidly absorbed in saliva and oral mucosa.[15] Also, as the analyzer pulls mercury contaminated air out of the mouth, mercury concentrations are also decreased as mercury free ambient air rushes into the oral cavity.[16]

13. When it comes to amalgam fillings, the concern is chronic, *not acute*, exposures. Basically, in the case of an acute exposure, one would be exposed to a large amount of mercury in a single dosage which, in and of itself, may or may not be toxic. In the case of chronic exposures, while an individual exposure may not be toxic, the concern is the sum of the exposures. With amalgams, the mercury exposure is constant, 24 hours a day (*chronic*), and increases with the introduction of various elements, such as chewing and the like, and also the introduction of other chemicals which may act synergistically with mercury. Furthermore, mercury accumulates within the human body in various organs and remains there for prolonged periods of time. In fact, mercury has been shown to remain in human organs for years after initial exposure accumulating in the brain, kidney, and lung.[17] Specific to amalgam and the nervous system, low doses of mercury vapor enter and remain within motor neurons for prolonged periods of time. Thus, even very low mercury exposure levels, that are well within

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[15]*See e.g.*, Lussi, A., *Mercury release from amalgam into saliva*, Schweiz Monatsschr Zahnmed,1993, 103(6):722-29 (showing mercury release from amalgams into saliva);
Pizzichini, M., Fonzi, M., Sugherini, L., Fonzi, L., Gasparoni, A., Comporti, M., Pompella, A., *Release of mercury from dental amalgam and its influence on salivary antioxidant activity* Dept. of Biomedical Sci., Univ. of Siena, Italy. Sci Total Environ 2002 Feb 4; 284 (1-3): 19-25.

[16]*See* Vimy, M.J., Lorscheider, F.L. *Dental amalgam mercury daily dose estimated from intra-oral vapor measurements; a predictor of mercury accummulation in human tissues* J. Trace Elements in Experimental Medicine 3, 111-123, 1990.

[17]*See e.g.*, Opitz H, Schweinsberg F, et al., *Demonstration of mercury in the human brain and other organs 17 years after metallic mercury exposure*, Clin Neuropathol 1996 May-Jun; 15(3): 139-44.

safe occupational limits proposed by WHO guidelines, will continue to accumulate in nerve cells.[18] This shows that amounts of mercury that are considered within safe limits reach the central nervous system, and can accumulate to toxic levels. Mercury can be lodged in various organs causing toxicity for a prolonged period of time. This is of particular concern with amalgams, as mercury continuously accumulates in a given subject for years, adding up to potentially toxic levels in many individuals, including, as noted below, the developing fetus.

14. Any claim that a zinc oxide layer is formed on the amalgams that decreases mercury release can only be true if an individual is not using his or her teeth. However, in the real world, any zinc oxide layer is easily removed by slight abrasion such as chewing food or brushing the teeth. Further, it has been confirmed that solutions in which amalgams have been soaked can cause the disassembly of brain proteins that are inhibited by adding mercury chloride, and these are the same enzymes inhibited in Alzheimer's Disease ("AD") brain samples.[19]

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[18] *See e.g.*, Pamphlett R, Coote P, *Entry of low doses of mercury vapor into the nervous system*, Neurotoxicology 1998 Feb; 19(1): 39-47.

[19] *See e.g.*, Duhr, E.F., Pendergrass, J. C., Slevin, J.T., and Haley, B. HgEDTA Complex Inhibits GTP Interactions With The E-Site of Brain β-Tubulin Toxicology and Applied Pharmacology 122, 273-288, 1993.

See also, Pendergrass, J.C. and Haley, B.E. *Mercury-EDTA Complex Specifically Blocks Brain β-Tubulin-GTP Interactions: Similarity to Observations in Alzheimer's Disease.* p 98-105 in Status Quo and Perspective of Amalgam and Other Dental Materials (International Symposium Proceedings ed. by L. T. Friberg and G. N. Schrauzer) Georg Thieme Verlag, Stuttgart-New York, 1995;

Pendergrass, J.C. and Haley, B.E. *Inhibition of Brain Tubulin-Guanosine 5'-Triphosphate Interactions by Mercury: Similarity to Observations in Alzheimer's Diseased Brain. In Metal Ions in Biological Systems* v34, pp 461-478;

Mercury and Its Effects on Environment and Biology, Chapter 16. Edited by H. Sigel and A. Sigel. Marcel Dekker, Inc. 270 Madison Ave., N.Y., N.Y. 10016, 1996;

Pendergrass, J. C., Haley, B.E., Vimy, M. J., Winfield, S.A. and Lorscheider, F.L. *Mercury Vapor Inhalation Inhibits Binding of GTP to Tubulin in Rat Brain: Similarity to a Molecular Lesion in Alzheimer's Disease Brain.* Neurotoxicology 18(2), 315-324, 1997;

David, S., Shoemaker, M., and Haley, B. *Abnormal Properties of Creatine kinase in Alzheimer's Diseased Brain: Correlation of Reduced Enzyme Activity and Active Site Photolabeling with Aberrant Cytosol-Membrane Partitioning.* Molecular Brain Research 54, 276-287, 1998;

Hock C, Drasch G, Golombowski S, et al. *Increased blood mercury levels in patients with alzaheimer's disease*, J Neural Transm 1998; 105(1): 59-68;

15. Amalgams emit significant levels of neurotoxic mercury that are injurious to human health and would exacerbate the medical condition of those individuals with neurological diseases such as AD. For example, mercury inhibits the same enzymes and structural proteins in normal brain tissues as are inhibited in Alzheimer's Disease.[20] AD is pathologically confirmed post-mortem by the appearance of neuro-fibillary aggregates and amyloid plaques in brain tissue. Published research, within the past year, has shown that exposure of brain neurons in culture to sub-lethal doses of mercury (much less than is observed in human brain tissue) causes the formation of neuro-fibrillary aggregates,[21] the increased secretion of amyloid protein and the hyper-phosphorylation of a protein called Tau.[22] All three of these mercury-induced aberrancies

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[20]*See e.g.*, Duhr, E.F., Pendergrass, J. C., Slevin, J.T., and Haley, B. HgEDTA Complex Inhibits GTP Interactions With The E-Site of Brain β-Tubulin Toxicology and Applied Pharmacology 122, 273-288, 1993.

See also, Pendergrass, J.C. and Haley, B.E. *Mercury-EDTA Complex Specifically Blocks Brain β-Tubulin-GTP Interactions: Similarity to Observations in Alzheimer"s Disease.* p 98-105 in Status Quo and Perspective of Amalgam and Other Dental Materials (International Symposium Proceedings ed. by L. T. Friberg and G. N. Schrauzer) Georg Thieme Verlag, Stuttgart-New York, 1995;

Pendergrass, J.C. and Haley, B.E. *Inhibition of Brain Tubulin-Guanosine 5'-Triphosphate Interactions by Mercury: Similarity to Observations in Alzheimer's Diseased Brain. In Metal Ions in Biological Systems* V34, pp 461-478;

Mercury and Its Effects on Environment and Biology, Chapter 16. Edited by H. Sigel and A. Sigel. Marcel Dekker, Inc. 270 Madison Ave., N.Y., N.Y. 10016 (1996);

Pendergrass, J. C., Haley, B.E., Vimy, M. J., Winfield, S.A. and Lorscheider, F.L. Mercury Vapor Inhalation Inhibits Binding of GTP to Tubulin in Rat Brain: Similarity to a Molecular Lesion in Alzheimer's Disease Brain. Neurotoxicology 18(2), 315-324 (1997);

David, S., Shoemaker, M., and Haley, B. *Abnormal Properties of Creatine kinase in Alzheimer's Diseased Brain: Correlation of Reduced Enzyme Activity and Active Site Photolabeling with Aberrant Cytosol-Membrane Partitioning.* Molecular Brain Research 54, 276-287 (1998);

Hock C, Drasch G, Golombowski S, et al. *Increased blood mercury levels in patients with alzaheimer's disease*, J Neural Transm 1998; 105(1): 59-68;

[21]Leong, CCW, Syed, N.I., and Lorscheider, F.L. *Retrograde Degeneration of Neurite Membrane Structural Integrity of Nerve Growth Cones Following In Vitro Exposure to Mercury.* NeuroReport 12 (4): 733-737, 2001.

[22]Olivieri, G., Brack, Ch., Muller-Spahn, F., Stahelin, H.B., Herrmann, M., Renard, P; Brockhaus, M. and Hock, C. Mercury Induces Cell Cytotoxicity and Oxidative Stress and Increases β-amyloid Secretion and Tau Phosphorylation in SHSY5Y Neuroblastoma Cells. J. Neurochemistry 74, 231-231, 2000.

are regularly identified as the major diagnostic markers for AD.

16. Furthermore, mercury from amalgams is transferred from a pregnant mother to the developing fetus, causing increased mercury body burden in newborn children solely based on the presence of amalgams in the mother.[23] Mercury exposure is even more devastating to the developing brain than to an adult brain. I and my colleagues conducted a study showing brain neuron degeneration from small amounts of mercury and conclusively proving that this type of degeneration does not occur with the introduction of other metallic elements, including *Lead.* Our study has been published in April, 2001, and the film that accompanies our study is available on the web; this being the first animated version of a study to be peer-reviewed and published, and is attached hereto as Exhibit "B."[24] Viewing this film, it is easy to see one of the major concerns regarding exposure to mercury from amalgam.

17. Also, low level exposures like those associated with amalgam fillings and the resultant increase in the mercury body burden are toxic to the central nervous system.[25] These

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[23]*See e.g.*, Razagui IB, Haswell SJ, *Mercury and selenium concentrations in maternal and neonatal scalp hair: relationship to amalgam-based treatment received during pregnancy*, Biol Trace Elem Res 2001 Jul; 81(1) 1-19;

Drasch G, Schupp I, Hofl H, et al., *Mercury burden of human fetal and infant tissues*, Eur J Pediatr. 1995 Jul; 154(7): 585-6;

Vimy, M.J., Takahashi, Y, Lorscheider, F.L. *Maternal-Fetal Distribution of Mercury Released From Dental Amalgam Fillings*, Amer.J.Physiol.,1990, 258:R939-945;

Vimy, M. J., Hooper, D. E., King, W. W., Lorscheider, F. L., *Mercury from maternal "silver" tooth fillings in sheep and human breast milk. A source of neonatal exposure* Biol Trace Elem Res 1997 Feb; 56 (2): 143-52

Takahashi, Y., Tsuruta, S., Hasegawa, J., Kameyama, Y., Yoshida, M., *Release of mercury from dental amalgam fillings in pregnant rats and distribution of mercury in maternal and fetal tissues*, Toxicology 2001 Jun 21; 163 (2-3): 115-26.

[24]Lorscheider FL, Leong C, Syed NI, *How mercury causes brain neuron degeneration*, Neuro Rpt, 2001 12(4): 733-737, http://movies.commons.ucalgary.ca/mercury.

[25]*See e.g.*, Echeverria D, Aposhian HV, Woods Js, Heyer NJ, et al., *Neurobehavioral effects from exposure to dental amalgam Hg: new distinctions between recent exposure and Hg body burden*, FASEB J 1998 Aug, 12 (11): 971-80;

See also, Aschner M, Aschner JL, *Mercury neurotoxicity: mechanisms of blood-brain barrier transport*, Neurosci Biobehav Rev 1990 Summer; 14(23): 169-76.

see also, Yeates KO, Mortensen ME *Acute and chronic neuropsychological consequences of mercury vapor poisoning in two early adolescents* Clin Exp Neuropsychol 1994 Apr; 16(2): 209-

can cause from severe to subtle neuropsychological functions such as depression of performance intellectual functioning, impairments of attention, impairment of short-term memory function, visual judgement of angles and directions, psychomotor retardation and personality changes. As further proof that these are mercury related, other investigators have shown that in some cases, the effects can be reversed simply by removal of the source of mercury intoxication, together with proper medical treatment.[26]

18. Mercury from dental fillings has also been associated with adverse effects in the cardiovascular system, including high blood pressure, low heart rate, low hemoglobin, and low hematocrit.[27]

19. Many of the experiments that show mercury emission and exposure from dental amalgams are so simple that they could have and should have been performed many years ago, in the 1950's and 60's. Yet, they were not performed.

20. In summary, based on my research expertise and the foregoing cited research evidence, it is my opinion that the risks associated with amalgam should be disclosed Mercury amalgam clearly presents a risk of adverse health effects. There are a number of substitute treatments, many of which are equal or superior to amalgam; the setting under which amalgams are placed are situations where there is no emergency, the patient is conscious, and is able to understand all necessary health risks associated with mercury amalgam and to consider

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Fredriksson A, Dahlgren L, Danielsson B, et al., *Behavioural effects of neonatal metallic mercury exposure in rats* Toxicology 1992 Sep; 74(2-3): 151-60.

[26]*See e.g.*, Hua MS, Huang CC, Yang YJ, *Chronic elemental mercury intoxication: neuropsychological follow-up case study*, Brain Inj. 1996 May; 10(5): 377-84;

Siblerud RL, *A comparison of mental health of multiple sclerosis patients with silver/mercury dental fillings and those with fillings removed*, Psychol Rep 1992 Jun; 70(3Pt 2); 1139-51;

[27]*See also*, Carmignani M, Boscolo P, *Cardiovascular homeostasis in rats chronically exposed to mercuric chloride*, Arch Toxicol Suppl. 1984; 7:383-8.