

MERCURY EXPOSURE FROM MAGICO-RELIGIOUS USE IN HISPANIC AND CARIBBEAN HOMES

Arnold P. Wendroff, Ph.D.; Daniel A. Jetter, M.P.H.

Mercury Poisoning Project

544 Eighth Street

Brooklyn, NY 11215-4201

mercurywendroff@mindspring.com

Key words

mercury, mercury vapor, elemental mercury, domestic mercury exposure, environmental justice, Hispanic health, ethnomedicine, indoor air pollution, magic, religion, iatrogenesis

Abstract

Mercury metal is sold in unlabeled containers by shops called *botanicas*, whose Hispanic and Caribbean clients put it to a variety of magico-religious uses, including sprinkling it on floors, placing it in open containers and ingesting it. These and other uses pollute dwellings with mercury, and expose occupants to potentially toxic levels of mercury and mercury vapor. The extent, magnitude and health effects of these magico-religious mercury exposures are unknown, and warrant investigation.

Introduction

Mercury metal was commonly used in biomedicine into the 1940's, when evidence of its fetotoxicity, teratogenicity (1,2) and adult toxicity (3,4) accelerated its removal from the armamentarium. Mercury-silver amalgam remains in wide use for dental fillings, despite evidence that it migrates throughout the body. (5)

Concern over non-industrial mercury exposure is reflected in the on-going studies of absorption of methylmercury from fish eating, and of elemental mercury from dental amalgam. (6) However recently described exposures to, (7,8) and absorption of elemental mercury from its magico-religious uses in Hispanic and Caribbean homes are likely to be "orders of magnitude greater" (9) than either 'fish or filling' exposures. "Metallic mercury has been used by Mexican-American ... populations in folk remedies for chronic stomach disorders." (10) "Metallic mercury is also used in certain occult practices (e.g., voodoo, santeria). One occult use involves sprinkling metallic mercury in a dwelling (7)." (11) The health effects of exposure to elemental mercury from its magico-religious and ethnomedical uses in the home have yet to be assessed. (12) This article describes this novel exposure route and its likely adverse health effects, reviews research and regulatory activity, and suggests steps to address the emerging environmental health and environmental justice issues associated with magico-religious mercury exposure.

Exposure Routes From Magico-Religious Mercury Use

The first report of the widespread sale of elemental mercury (*azogue* in colloquial Spanish) for magico-religious uses which were likely to contaminate dwellings was in 1990. (7) Shops called *botanicas* or *yerberias*, located in Hispanic and Caribbean communities throughout the United States and in Latin-American and Caribbean countries, retail mercury together with a wide variety of magico-religious paraphernalia. (13)

Followers of Santeria, Espiritismo, and Voodoo, religions practiced in and around the Caribbean, believe mercury attracts good and repels evil, and use it in various rituals. These religious and customary uses commonly involve placing mercury in open containers, devotional candles, perfume, and most problematic of all, sprinkling mercury in dwellings and autos. (7,8) Mercury put to occult use by placing it in open containers of oil, wine or perfume emits mercury vapor through the supernatant liquid into room air. Similarly, mercury used to "mop the floor" to rid a dwelling of malign influences, and then disposed of down a drain will contaminate plumbing traps and emit vapor into dwellings.

Mercury is given by ingestion for both ethnomedical and magical purposes, perhaps most commonly to infants for *the treatment of empacho*, a culturally defined constipation in which food is believed to adhere to the wall of the gut. (14,15) Ingesting heavy, mobile mercury is believed to dislodge the adherent food. As 0.01% of ingested mercury is absorbed via the gut, (10) it likely poses a threat to an infant's developing brain, as a 10g dose (less than 1ml) would result in the absorption of 1mg of mercury.

Extent of Domestic Mercury Use

The initial (1990) report of suspected widespread "Domestic mercury pollution," (7) found that around the U.S. (including Puerto Rico) in cities with large Hispanic populations, most *botanicas* queried (99 of 115) sold mercury. *Botanicas* in Colombia, the Dominican Republic and Mexico also reported selling mercury. The mean weight of mercury sold by 28 *botanicas* surveyed in New York City was 9g (range 1.5 - 31.3g) with a modal cost of \$1. One hardware store in Manhattan with a window sign advertised "Quicksilver Mercury por la Santoria" [sic], and sold unlabeled vials of over 90g of mercury for \$4.

A 1992 survey of *botanicas* in a Central American neighborhood of Los Angeles found mercury widely sold, with eight samples having a mean weight of 12.1 grams (range 1.8 - 21.4 grams). Over half the shops recommended that mercury be used in a manner likely to result in mercury vapor pollution of indoor air. (Harawa N:personal communication)

A 1995 survey of 12 *botanicas* in Brooklyn, found all selling mercury, and "most denied or were unaware that there were any dangers in using the mercury." (Adams P:personal communication)

A 1996 report found that 35 *botanicas* in the Bronx collectively sold some 150 9g units per day, or 47,000 units totalling >420kg of mercury yearly. (8) Of the ritual experts they consulted, 29% recommended mercury be sprinkled in the home, 2% that it be sprinkled in cars, and 2% that it be ingested. These statistics suggest that >13,000 Bronx dwellings each year will have a mean weight of 9g of mercury sprinkled in them, or that some lesser number of dwellings will have a multiple of 9g strewn on their floors; amply illustrating "the public health threat of dispensing mercury." (8)

In 1997 a study sponsored by EPA found that of 79 Hispanic adults interviewed in Chicago, 15 put mercury to magico-religious uses. (16) An unpublished study by Dr. Clyde Johnson of the City University of New York, released to the EPA and to the New York City Department of Health, found that among 203 adults resident in New York City, and of Caribbean or Latin American ethnicity, 44% of the former, and 27% of the latter "stated that elemental mercury is used in their homes, cars or carried on their person." 64% of those interviewed stated that the mercury was disposed of in household garbage.

Elsewhere in the Hemisphere, in a study of mercury pollution from gold mining in French Guinea, Haitian women in a control group remote from mining activities exhibited elevated hair mercury levels believed due to magico-religious exposure. (Cordier S; Taverne B:personal communications)

Likely Adverse Health Effects of Magico-Religious Mercury Exposure

The minimal risk level (MRL) for chronic mercury vapor inhalation has been set at 0.3 microgram per cubic meter. (17) This MRL is evidently exceeded in some dental offices, and elevated urine mercury levels in dentists, with attendant subtle behavioral effects, are primarily attributed to spilled mercury. (18,19) This is not surprising, as "an eyedropper size drop of mercury contains enough mercury to saturate the air in a typical size [dental] operator." (20) The typical volume of mercury dispensed by the *botanicas* surveyed in New York, (and presumably sprinkled on the floor of a dwelling) was in excess of 30 drops; (7) a far greater amount than would be allowed to remain on the floor of a dental operator.

In 1996, an apartment in Connecticut suspected of mercury contamination from magico-religious use contained Santeria paraphernalia and had a mercury vapor level of 40ug/m³. (Toal B:personal communication) As urban homemakers and their young children spend much of their time inside their homes, they are especially at risk from the hazards of domestic mercury vapor exposure. Mercury sprinkled inside "automobiles for good

luck,"(8) can only add to their exposure.

Intoxication has occurred from second-hand exposure to mercury spills of prior residents. (21) Identifying individuals subject to second-hand exposure is difficult, as occupants are generally unaware of prior mercury pollution. When mercury is detected in the home, there are many difficulties to be surmounted in the clean-up and disposal of contaminated materials. (17,22,23) "Explorations of mercury levels in inner-city communities should include adherents of spiritualism as well as nonadherents since the latter may be exposed unwittingly to mercury poisoning by residing in apartments and homes previously inhabited by mercury-sprinkling tenants." (8)

The toxic potential of domestic mercury spills much smaller than the 9g dose typically presumed put to magico-religious use, was demonstrated by a report (24) of acrodynia (a rare manifestation of chronic mercury exposure) in three small children, who required hospitalization and chelation therapy as a consequence of their exposure to the vapor emanating from a single broken clinical thermometer containing less than 1g of mercury; or about 1/10 the mean weight sold (and presumably sprinkled on floors at one time) by *botanicas* in New York City. Another case of acrodynia was attributed to the even smaller amount of mercury emanating from broken fluorescent light bulbs. (25) Children who develop acrodynia may be better off than those that absorb mercury but remain asymptomatic, as their symptoms draw attention to their mercury exposure, and invoke medical intervention to prevent neurological damage.

The case of the broken thermometer exposure (24) illustrates the "dilemma ... that urine or blood mercury concentrations may often be nondiagnostic in persons with chronic exposure, who have gradually developed an extensive and relatively unexchangeable tissue mercury burden." (22) Domestic mercury exposure is highly variable, and a wide variety of micro-environments and individual physiological differences will contribute to varied individual absorption and health effects. There is also poor correlation between blood and urine mercury levels and clinical symptoms. (26) No elevated urine mercury level may be observed when mercury is bound in tissue, and a chelation challenge may be required to mobilize mercury so it can be detected in urine. (22,24) Unfortunately, most data on elemental mercury toxicology is derived from adult exposures, and "toxic urinary mercury concentrations have not been determined for children," (10) who are most susceptible to neurological damage from mercury exposure.

Repeated topical application of mercury in baths and perfumes, as recommended by some ritual experts, can result in absorption of toxic levels. (22) A study in Kings County Hospital in Brooklyn found a highly elevated (57ug/l) breast-milk mercury level in a Dominican woman who had added mercury to her cologne. Despite her elevated breast milk level, her urine mercury level was in the 'normal' range, about 5ug/l. (Arbit D, Unpublished lecture) The Food and Drug Administration's maximum allowable mercury in cow's milk is <4ug/l. (27)

There is a dearth of data on the effects of intrauterine exposure to mercury vapor, (28) and of elevated breast milk mercury levels on nursing infants. (29) There is evidence that maternal absorption of mercury can disrupt the menstrual cycle, cause reproductive failure (2) and lower birth weight. (30) Paternal exposure to mercury vapor has been associated with spontaneous abortions. (31)

Even in industrial settings with much higher mercury levels, "because of the nonspecificity of the symptoms of subacute mercury poisoning, there are few reports of illness that is bound to occur." (32) "While no cases of mercury intoxication from this [magico-religious] source have yet been identified, the nonspecific psychosomatic symptoms of mercury poisoning would likely be misdiagnosed as psychiatric illness unless special inquiry ... were conducted [in] high-risk populations." (33)

Chronic neuropsychological deficits in adolescents (34) and adults (35) resulting from mercury vapor exposure have been documented. The most worrisome effect of domestic mercury exposure is neurodevelopmental damage to children exposed in utero and infancy. Research suggests that mercury has behavioral effects similar to lead, (36) namely nonadaptive (37) as well as aggressive (38) behavior. Mercury levels previously believed to be harmless may produce emotional disturbances in children. (39,40) A synergistic depression of intelligence levels may be induced by exposure to low levels of both lead and mercury, (41) and a disproportionate number of Hispanic children are exposed to lead in their homes.

Mercury exposure can cause psychological deficits at all stages in the life cycle, in geriatric (3) as well as pediatric populations; and the most sensitive test for these subtle effects of mercury toxicity is by neuropsychological testing. (33,42)

As "deficits in psychological and classroom performance" are associated with elevated dentine lead levels, (43) it is equally likely that similar deficits will be detected when teeth of children suffering from early mercury exposure are analyzed for their mercury content. (44)

A "Natural Experiment"

A recent series of domestic mercury spills from a common source occurred in Florida, where children found some discarded mercury and took it to a local high school, then divided it up in small containers, and brought them to 50 of their homes. The amounts of mercury scattered, while not measured, were estimated to be "very small." (Malecki JM:personal communication) The school and 17 homes were sufficiently contaminated to warrant evacuation, and although asymptomatic, 54 persons were found to have elevated blood and/or urine mercury levels, after being exposed for about three weeks. (23) This mode of mercury contamination is congruent with that resulting from its scattering in small amounts for magico-religious uses. However the brief duration of the Belle Glade exposures should be contrasted with the months or possibly years in homes where mercury is used for magico-religious purposes.

Regulatory Responsibility and Response

In the Belle Glade spills, the Environmental Protection Agency (EPA) responded with alacrity, although no symptoms of mercury poisoning were observed. Under the provisions of "Superfund," EPA assumed primary responsibility for the mercury cleanup within a day of the spills being discovered. Despite numerous decontamination efforts costing some \$740,000, it took EPA three months to clean up the 17 contaminated dwellings, which were mainly single story dwellings with cement-slab floors, as well as a few house-trailers. Inner-city apartments with wood flooring are much more difficult to decontaminate. A major factor deterring the EPA and other agencies from addressing magico-religious mercury pollution, is the enormous expenditure required to clean up such spills. It cost >\$30,000 to decontaminate each of the 17 dwellings in Belle Glade. Some 13,000 9g doses of mercury sold each year in the Bronx are destined for sprinkling in homes. (8) If only 1,000 of these dwellings were contaminated and required remediation, the cleanup would cost some \$30,000,000. Acting to prevent such exposures in the first place, by enforcing existing labeling regulations and implementing consumer education based on clinical research findings would be a cost-effective means of reducing morbidity from chronic exposure to mercury.

The EPA has the authority to regulate the sale and use of mercury for domestic use under the provisions of the Toxic Substances Control Act, (45) although to date EPA has refused to invoke its regulatory authority. Similarly, although the Agency for Toxic Substances and Disease Registry's (ATSDR) responsibilities include conducting studies "to determine the relationships between human exposure to hazardous substances and the occurrence of adverse health outcomes," (42) the ATSDR has largely ignored domestic mercury exposure, while devoting considerable attention to methylmercury exposure. "When ATSDR identifies a significant risk to human health, the [Superfund ... Act of 1986 (SARA)] directs EPA to reduce the exposure and eliminate or mitigate the risk." (46) ATSDR's failure to conduct an adequate risk assessment of domestic mercury exposure, has helped perpetuate EPA's inaction on this matter.

More than 90% of mercury sold for magico-religious purposes bears no label, a clear violation of the Consumer Product Safety Commission's (CPSC) regulations (47) mandating that all "toxic" substances, and in particular "neurological" and "developmental or reproductive toxicants," bear identification and warning labels. However "the use of mercury for religious and ethnomedical uses in the home appears low and, therefore, is low on the Commission staff's enforcement priorities." (Schmeltzer D:personal communication) This failure to provide "informative labeling of hazardous substances [such as mercury] so as to warn the public against the

dangers involved in the use of the substances in order that users may take necessary and adequate precautions against risk of bodily harm," is also a violation of the New York City Health Code. (48)

Environmental Justice

Attitudes and behaviors regarding environmental risks vary among ethnic groups, (15,49,50) and mercury's toxic nature is either not appreciated by many of its users, or is consciously minimized in accordance with cultural norms. It will be necessary to modify these norms in order to eliminate the risk of mercury poisoning in the home from its magico-religious uses. (51)

That users of mercury are reluctant for the wider community to learn of their occult practice is to be expected. However Hispanic and Caribbean 'gatekeepers,' including Hispanic public health and medical professionals, have for the most part intentionally ignored and denied the magico-religious mercury issue for fear of the embarrassment it is likely to bring to their community. An apt illustration of this was when an article on the subject (52) in a major American Spanish-language medical journal (circulation >30,000) elicited not a single response.

"Empowerment [defined as] ... the reality and perception that the person undergoing the risk has some control over the risk, ... plays the dominant role in personal judgements of risk." (53) In the case of domestic mercury use, "the person undergoing the risk has [total] control over the risk," but no appreciation of it. In fact the use of mercury is perceived as a means of avoiding harm from malign influences, as a cure of disease, or as a means of enhancing one's luck, as the illustrated by the following newspaper excerpt:

"Most botanica owners and their customers don't regard *azogue* as a health threat. Many sellers either downplay the danger or say they know nothing about it. Many practitioners also deny any knowledge of possible mercury poisoning. "I would not sell it [mercury] if I believed it hurt people" said Reynaldo Silva, manager of Botanica Discount Center in Miami. "I've also used it in small amounts in my house, and my family is well"" (50)

In a similar vein, a *yerberia* proprietor in Mexico selling *greta* (lead oxide) for ethnomedical use by ingestion:

"knew that lead was harmful for some people ... , [but it] was not harmful to his people. ... Mexicanos had used it for so many generations that they had adapted to it. ... The fact that lead [and mercury] poisoning is so frequently asymptomatic and the consequences often hard to distinguish from other common health problems probably combined with the natural resistance of cultural traditions to externally induced modification to ... [form his] view of the situation." (15)

Environmental justice issues typically coalesce around the 'outrage factor' evoked when a poor and/or minority community sees itself as being environmentally imposed upon by the 'outside' majority, and demands relief. This "Engage[ment of] Stakeholders," is the starting point from which all of the steps in risk assessment and risk management evolve, as described in the recent Framework for Environmental Health Risk Management. (54) As there no "engage]ment" of the crucial "stakeholders," those using mercury and those exposed to it, there is no foundation on which to construct the "Framework" necessary to assess and manage the "Risk."

Apropos of this "risk," the Health and Research Subcommittee of EPA's National Environmental Justice Advisory Council (NEJAC) unanimously passed a resolution to the EPA Administrator that EPA "examine ... the extent to which mercury poisoning associated with domestic use in cultural practices is a health problem, and where the responsibility lies within the federal agencies to address this issue." (55) To date, the EPA Administrator has failed to answer the two questions raised by the NEJAC resolution.

"To respond effectively, individuals need psychological resources like sufficient self esteem to assert their interests, and intellectual resources such as enough education to understand technological and health issues." (56)

Those using mercury in their homes evidently lack an understanding of the health issues involved. The issue of lack of self esteem becomes important when users realize the damage they have inflicted on themselves and their families, which may give rise to guilt and loss of self esteem, both of which act to prevent the users from acknowledging that there is a problem, and preclude them from taking substantive steps to address and remedy the problem.

Actions Required to Address the Problem

Steps to address the health problems posed by magico-religious mercury use are in general similar to those addressing domestic lead exposure. However the lack of user awareness of mercury's toxicity puts an even greater emphasis on research, labeling, health education, and possible regulatory action. These steps include:

- a) Enforcement of existing mercury labeling regulations.
- b) Clinical studies to convince mercury users (as well as the environmental health research and clinical communities) that magico-religious mercury use is hazardous to human health.
- c) Health education programs based on clinical evidence.
- d) Case-finding campaigns coupled with environmental mercury measurements, biomarker measurements of mercury absorption, and neuropsychological assessment.
- e) Treatment programs, including chelation challenge availability, and liaison with school health and psychological assessment personnel.
- f) Environmental decontamination programs, under the aegis of "Superfund," including the provision of 'safe houses' during decontamination.

Conclusion

Magico-religious mercury use poses serious environmental health problems and raises important research questions. It also raises ethical and policy issues, including the conflict between the need for environmental justice and the need for cultural sensitivity. It is hoped that the environmental health and mercury toxicology communities will begin to address some of these questions and issues in culturally sensitive yet substantive ways.

References

1. Koos BJ, Longo LD. "Mercury toxicity in the pregnant woman, fetus, and newborn infant." *American Journal of Obstetrics and Gynecology*, 126(3):390-409 (1976).
2. Sikorski R, Juszewicz T, Paszowski T, Sprengier-Juszewicz T. "Women in dental surgeries: reproductive hazards in occupational exposure to metallic mercury." *International Archives of Occupational and Environmental Health*, 59:551-557 (1987).
3. Gilewski MJ. "Probable behavioral side effects of a mercury preparation." *Clinical Gerontologist*, 3(4):69-71 (1985).
4. Bourgeois M, Dooms-Goosens A, Knockaert D, Sprengers D, Van Boven M, Van Tittleboom T. "Mercury intoxication after topical application of a metallic mercury ointment." *Dermatologica*, 172(1):48-51 (1986).
5. Lorscheider FL, Vimy MJ, Summers AO. "Mercury exposure from "silver" tooth fillings: emerging evidence questions a traditional dental paradigm." *FASEB Journal*, 9:504-508 (1995).
6. Wheeler M. "Measuring mercury." *Environmental Health Perspectives*, 104(8):826-831 (1996).
7. Wendroff AP. "Domestic mercury pollution." *Nature*, 347:623 (Scientific Correspondence.) (1990).
8. Zayas LH, Ozuah PO. "Mercury use in *Espiritismo*: A survey of botanicas." *American Journal of Public Health* 86(1):111-112(1996).
9. Wendroff AP. "Magico-religious mercury exposure." *Environmental Health Perspectives*, Letter to Editor. 105(3):266 March (1997).
10. ATSDR. Mercury Toxicity. Case Studies in Environmental Medicine #17. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. March (1992).
11. ATSDR. Toxicological Profile for Mercury. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service (1994).
12. *Environmental Health Letter*. Ritual uses of mercury may place minority communities, kids at risk. 36(15):144 (1997).
13. Ojito, M. "Ritual use of mercury prompts testing of children for illness." *The New York Times* 12/14/97 pp 49&55 (1997).
14. Geffner M, Sandler A. "Oral metallic mercury: A folk medicine remedy for gastroenteritis." *Clinical Pediatrics*, 19:435- 437 (1980).
15. Trotter RT II. "The cultural parameters of lead poisoning: A medical anthropologist's view of intervention in environmental lead exposure." *Environmental Health Perspectives*, 89:79-84 (1990).
16. Chicago Department of Public Health. Mercury Use in the Hispanic Community of Chicago. July (1997).

17. MMWR. "Acute and chronic poisoning from residential exposures to elemental mercury - Michigan, 1989-1990. Centers for Disease Control, *Morbidity and Mortality Weekly Report*, 40(23):393-395 (1991).
18. Martin MD, Naleway C, Chou H. "Factors contributing to mercury exposure in dentists." *The Journal of the American Dental Association*, 126(11):1502-1511 (1995).
19. Echeverria D, Heyer NJ, Martin MD, Naleway CA, Woods JS, Bittner AC. "Behavioral effects of low-Level exposure to Hg⁰ among dentists." *Neurotoxicology and Toxicology*, 17(2):161-168 (1995).
20. Phillips RW. Skinner's Science of Dental Materials. 8th ed. pp. 348-9, Saunders, Philadelphia (1982).
21. MMWR. "Elemental mercury vapor poisoning - North Carolina, 1988. *Morbidity and Mortality Weekly Report*, 38(45):770-772, 11/17/89 (1989).
22. Florentine MJ, Sanfilippo DJ II. "Elemental mercury poisoning." *Clinical Pharmacy*, 10:213-221 (1991).
23. MMWR. Mercury exposure in a residential community -- Florida, 1994. 44(23):436-7,443. *Morbidity and Mortality Weekly Report*, 6/16/93 (1995).
24. von Muhlen Dahl KE. "Intoxication from mercury spilled on carpets." *The Lancet*, Vol. 336:1579 (1990).
25. Tunnessen WW Jr, McMahon KJ, Baser M. "Acrodynia: Exposure to mercury from fluorescent bulbs." *Pediatrics*, 79(5):786-789 (1987).
26. Taueg C, Sanfilippo DJ, Rowens B, Szejda J, Hesse JL. "Acute and chronic poisoning from residential exposures to elemental mercury." *Clinical Toxicology*, 30(1):63-67 (1992).
27. ATSDR. Reproductive and Developmental Hazards. Case Studies in Environmental Medicine #29. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. September (1993).
28. Thorp JM Jr., Boyette DD, Watson WJ, Cefalo RC. "Elemental mercury exposure in early pregnancy." *Obstetrics & Gynecology*, 79(Section 5; Part 2):874-875 (1992).
29. Jensen AA, Slorach SA. Chemical Contaminants in Human Milk. CRC Press, Boca Raton, FL. (1991).
30. Sikorski R, Paszkowski T, Szprengier-Jusziewicz T. "Mercury in neonatal scalp hair." *The Science of the Total Environment*, 57:105-110 (1986).
31. Cordier S, Deplan F, Mandereau L, Hemon D. "Paternal exposure to mercury and spontaneous abortions." *British Journal of Industrial Medicine*, 48:375-381 (1991).
32. Hardy HL, Finkel AJ. Hamilton and Hardy's Industrial Toxicology. John Wright - PSG Inc. Boston (1983).
33. Hartman DE. Neuropsychological Toxicology: Identification and Assessment of Human Neurotoxic Syndromes. Second edition. (Critical Issues in Neuropsychology [series]) Plenum Press, New York & London (1995).
34. Yeates KO, Mortensen ME. "Acute and chronic neuro-psychological consequences of mercury vapor poisoning in two early adolescents." *Journal of Clinical & Experimental Neuropsychology* 16(2):209-222 (1994).
35. Liang YX, Sun RK, Sun Y, Chen ZQ, Li LH. "Psychological effects of low exposures to mercury vapor: Application of a computer-administered neurobehavioral evaluation system." *Environmental Research* 60(2):320-327 (1993).
36. Hanninen H. "Behavioral effects of occupational exposure to mercury and lead." *Acta Neurologica Scandinavica*, 66(Suppl92):167-175 (1982).
37. Marlowe M, Cossairt A, Moon C, Errerra J, MacNeel A, Peak R, Ray J, Schroeder C. "Main and interaction effects of metallic toxins on classroom behavior." *Journal of Abnormal Child Psychology*, 13(2):185-198 (1985).
38. Marlowe M, Cossairt A, Moon C, Errera J, MacNeel A, Peak R, Ray J, Schroeder C. "Main and interaction effects of metallic toxins on aggressive classroom behavior." *Aggressive Behavior*, 11(1):41-48 (1985).
39. Marlowe M, Errerra J, Stellern J, Beck D. "Lead and mercury levels in emotionally disturbed children." *Journal of Orthomolecular Psychiatry*, 12(4):260-267 (1983).
40. Marlowe M. "Metal pollutant exposure and behavior disorders: Implications for school practices." *Journal of Special Education*, 20(2):251-264 (1986).
41. Marlowe M, Moon C. "Correlation of metal-metal interactions as measured in hair on childhood intelligence." *Journal of Advancement in Medicine*. 1(4):195-203 (1988).
42. Amler RW, Gibertini M. Pediatric Environmental Neurobehavioral Test Battery. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. September (1996).
43. Needleman HL, Gunnoe C, Leviton A, Peresie H, Maher C, Barret P. "Deficits in psychological and classroom performance of children with elevated dentine lead levels." *New England Journal of Medicine*, 300:689-695 (1979).
44. Eide R, Wesenberg GB, Fosse G. "Mercury in primary teeth in preindustrial Norway." *Scandinavian Journal of Dental Research*, 101:1-4 (1993).
45. TSCA. 1986. "Toxic Substances Control Act [TSCA] (15 U.S.C.A. Sections 2601 to 2671)" in: Selected Environmental Law Statutes, 1989-90 Educational Edition. West Publishing, St. Paul MN (1989).

46. General Accounting Office. SUPERFUND: Public Health Assessments Incomplete and of Questionable Value. GAO/RCED-91-178 (August 1991) Washington, DC August (1991).
47. CPSC Subchapter C--Federal Hazardous Substances Act Regulations. Code of Federal Regulations, Commercial Practices, part 1500 to 1512, Revised 1/1/93. pp.376-462. USGPO:1993--341 812/82806 (1993).
48. RCNY. 1991. Rules of the City of New York. ARTICLE 173--HAZARDOUS SUBSTANCES (1991).
49. Vaughn E. "Individual and cultural differences in adaptation to environmental risks." *American Psychologist*, 48:6:673-680 (1993).
50. Fernandez, J. "The mercury hex." *The Palm Beach Post*, 9/14/94:1A,5A-6A (1994).
51. Wendroff AP. "Magico-religious mercury poisoning and cultural sensitivity." *American Journal of Public Health*, Letter to Editor. 85(3):409-410 March (1995).
52. Wendroff AP. "*El envenenamiento con mercurio*." *Medico Interamericano*, 10(11):64-68 (1991).
53. Hoffman R. "A response to worries about the environment," in The Same and Not the Same, Columbia University Press (1995).
54. Presidential/Congressional Commission on Risk Assessment and Risk Management. Framework for Environmental Health Risk Management. Final Report, Volume 1. Washington, DC (1997).
55. NEJAC. Summary of the Meeting of the National Environmental Justice Advisory Council. May 29-31, (1996).
56. Rich RC, Edelstein M, Hallman WK, Wandersman AH. "Citizen participation and empowerment: The case of local environmental hazards." *American Journal of Community Psychology*, 23(5):657-676 (1995).

1998 A.P.W.
04/29/01 format revision

NOTE: This paper was published with minor omissions but without references, in *Environmental Times*, pp. 1,8,16, Fall (December) 1999. This newspaper is the house organ of the Environmental Assessment Association. (320) 763-4320