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Rev. 07/10/02

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MASSACHUSETTS

CARMEN SANTIAGO, Individually and as Parent and Next Friend of MONICA SANTIAGO, Plaintiff, v. THE SHERWIN-WILLIAMS COMPANY, et al, Defendants.	CIVIL ACTION NO. 87-2799-T

AFFIDAVIT OF HOWARD W. MIELKE, Ph.D.

Howard W. Mielke, Ph.D., first being duly sworn, states the following:

1. I am currently an Associate Professor of Environmental Toxicology at Xavier Institute of Bioenvironmental Toxicology, Xavier University of Louisiana, College of Pharmacy, New Orleans, Louisiana. Prior to that, I was a research associate with the Center for Urban and Regional Affairs,

Hubert H. Humphrey Center, University of Minnesota, Minneapolis, Minnesota. I earned my Ph.D. in Geography in 1972 from the University of Michigan. I also earned a Masters of Science Degree in Biology from the University of Michigan and received my undergraduate degree from Macalester College.

2. I have devoted much of my professional career and research to the study of the sources of lead in the urban environment. I have been involved in several research projects concerning lead, and have specifically researched and studied the contribution of leaded gasoline emissions to urban soil and dust levels and children's blood lead levels. My study of lead in the urban environment includes my review of the scientific literature concerning lead. I have written several articles concerning lead in the urban environment, including Soil -- Dust Lead and Childhood Lead Exposure as a Function of City Size and Community Traffic Flow: The Case for Lead Contaminated Soil Abatement in

Minnesota (1989).[1/] The specifics of my education, training and experience are discussed in more detail in the copy of my current Curriculum Vitae which is attached hereto.

3. In the process of preparing this affidavit, I have reviewed the complaint and the affidavits of Drs. Needleman, Graef, Silbergeld, Landrigan, Gooch, and Banner. I have also reviewed a summary of Monica Santiago's blood lead levels during her early childhood years, and the City of Boston lead inspection report for 20 Leston Street, Mattapan, Massachusetts, which I understand is the former residence of Monica Santiago. I have also reviewed the deposition transcripts of Carmen and Reyito Santiago (the mother and father of Monica Santiago).

[1/] Mielke, H.W., Adams, J.L., Reagan, P.L. and Mielke, P.W. Jr., "Soil -- Dust Lead and Childhood Lead Exposure as a Function of City Size and Community Traffic Flow: The Case for Lead Contaminated Soil Abatement in Minnesota." In Lead in Soil: Issues and Guidelines. Davies, B.E., Wixson, B.G. (eds.) Environmental Geochemistry and Health Monograph Series 4, Supplement to Vol. 9. Science Reviews, Ltd., Norwood, U.K. pp. 253-271 (hereinafter "Minnesota Traffic Flow Study").

I am familiar with the history and prevalance of the use of leaded gasoline and data on vehicular traffic for various urban areas, including the City of Boston. I am also familiar with studies that have used leaded gasoline consumption and vehicular traffic data to estimate the amount of lead emitted from the combustion of leaded gasoline.[2/]

4. If called to testify in this case, I will be prepared to discuss and offer opinions regarding:

(1) the contribution of leaded gasoline emissions and other environmental sources to lead in soil and dust;

(2) the amount of lead introduced into the urban environment from the combustion of leaded gasoline, including the Mattapan, Roxbury, Dorchester and Jamaica Plain areas of Boston at various times including the 1970's;

(3) the contribution of lead in urban soil and dust to children's blood lead levels; and

(4) the potential sources of lead exposure that may have contributed to Monica Santiago's blood lead levels.

2/ See e.g., "An Ecosystem Analysis of Environmental Contamination by Lead," G. Rolfe and A. Handley, Institute for Environmental Studies, University of Illinois at Urbana-Champaign (1975).

I will base my testimony not only on my review of the information described in Paragraph No. 3, but also upon the investigations, studies, reports and information concerning lead in the environment contained in the published scientific literature and various governmental reports.

5. In the mid-1970's I participated in a study of garden soils in the inner-city area of Baltimore, Maryland.[3/] In this study, we found that lead (as well as cadmium, copper, nickel and zinc) was concentrated and ubiquitous in garden soil in the inner-city area of Baltimore. The clustering of elevated soil lead levels in the inner city, however, did not appear to be solely related to the weathering of painted surfaces and, in fact, appeared more closely related to patterns of leaded gasoline emissions. It also appeared that the soil lead levels near inner-city buildings (many of which were made of brick and had not been painted) was the

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[3/] See "Lead Concentrations in Inner-City Soils as a Factor in the Child Lead Problem" Mielke, H.W., J.C. Anderson, K.J. Berry, P.W. Mielke, Jr., R.L. Chaney, and M. Leach, American Journal of Public Health, 73(12):1366-1369.

result of airborne lead particles becoming impacted upon the sides of buildings and subsequently being washed off into the soil by precipitation.

6. I subsequently conducted research regarding soil lead levels in Minnesota to determine the contribution of leaded gasoline to urban soil and dust lead levels (the "Minnesota Traffic Flow Study"). The Minnesota Traffic Flow Study involved both an evaluation of soil lead in the cities of Minneapolis/St. Paul, Duluth, St. Cloud and Rochester, Minnesota, and an evaluation of relevant blood lead concentration data. This study tested the conventional hypothesis that lead-based house paint is the major source of urban lead contamination and childhood lead exposure. If this hypothesis were true, then children living in cities and communities with aged housing (we used the age of housing as a proxy for the presence of lead-based paint) should have similar blood lead levels and all dwellings painted with lead-based paint should have similar soil lead concentrations regardless of urban location.

7. We evaluated data on the soil/dust lead levels and children's blood lead concentrations in

the oldest housing areas of Minneapolis/St. Paul, Duluth, St. Cloud and Rochester, Minnesota. The Twin Cities of Minneapolis and St. Paul and the city of Duluth represented major urban areas while Rochester and St. Cloud represented smaller, less populated communities. All of the cities, however, had communities of older housing, which, due to the age of the housing, likely contained lead-based paint.

8. The results of the Minnesota research revealed fundamental differences among each of the cities in terms of both children's blood lead levels and soil lead concentrations. It was in the larger, more densly populated urban areas that we found elevated soil lead concentrations and higher blood lead levels. For example, the proportion of children with blood lead concentrations equal to or greater than 25 ug/dl was 3.7, 3.1, and 0.7 percent in the larger cities of Minneapolis, St. Paul, and Duluth, and the proportion of children with blood lead concentrations equal or greater than 15 ug/dl was 17.7 percent in Minneapolis, 14.9 percent in St. Paul and 9.8 percent in Duluth. In the smaller cities of St. Cloud or Rochester, however, no children were

found to have blood lead concentrations above 15 ug/dl.

9. The soil lead levels of samples taken from yards, street sides and near the foundations of buildings showed a similar trend with the highest levels being found in the larger cities of Minneapolis and St. Paul and the lowest levels in the smaller city of Rochester. For example, mid-yard soils above 150 ppm range from 67.5 percent in Minneapolis, 51.0 percent in St. Paul and 46.2 percent in Duluth to 4.8 percent in St. Cloud and 4.5 percent in Rochester. Although the soil lead levels near building foundations were found to be the highest, the concentrations found were not related to the age of the community's dwellings (the proxy used for the presence of lead-based paint). Because of the variations between the cities, we concluded that lead from vehicle exhaust made a substantial contribution to soil lead levels near the foundations of buildings. It is most likely that airborne lead becomes impacted on the side of a building and is subsequently washed into the soil by rainfall.

10. The Minnesota Traffic Flow Study reveals that lead-based paint alone does not appear to be the major cause of the accumulation of soil lead or of lead exposure of childhood populations. Rather, the survey data shows that the major patterns of soil lead are related to city size and traffic flow. The accumulation of airborne particles from leaded gasoline emissions was found to be related directly to soil lead contamination, as well as being associated with children's blood lead levels.[4/]

[4/]There have been several other reports which examined soil lead concentrations and have shown that soil lead levels are a function of traffic levels, city size and/or the distance from the center of large cities. See e.g., Wheeler, G. and Rolfe, G. (1979) "The Relationship Between Daily Traffic Volume and the Distribution of Lead in Roadside Soil and Vegetation," Environ. Poll., 18, 265-274; Hamilton, R.S., Revitt, D.M. and Warren, R.S., (1984) "Levels and Physio-Chemical Association of Cd, Cu, Pb and Zn in Roadside Sediments," Sci. Total Environ., 33, 59-74.

Furthermore, other reports have shown that soil/dust lead and blood lead levels decrease together as a function of distance from urban centers. See e.g., Brunekreef, B., Noy, D., Biersteker, K. and Boleij, J. (1983) "Blood Lead Levels of Dutch Children and their Relationship to Lead in the Environment," J. Air Poll. Cont. Assoc., 33, 872-876.

11. The significant correlation between the combustion of leaded gasoline and soil lead concentrations has also been shown through the study of ambient air lead concentrations. The United States Environmental Protection Agency ("EPA") found that during the 1970's, when the use of leaded gasolines was at its greatest, air lead levels decreased by 2 to 3 times from the center of a city to a city's edge. The EPA also concluded that soil lead levels were a direct function of the deposition of ambient air lead.[5/]

12. The lead from leaded gasoline emissions consists of (1) smaller particulate lead, which becomes airborne and is dispersed through the air a significant distance from the roadway, and (2) larger particles which settle closer to the road. The smallest airborne lead is less likely to settle out onto roadways, sidewalks or yards, but it does become impacted upon buildings and is subsequently washed into the soil by rainfall. The larger lead particles

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[5/] See EPA 1986. Environmental Criteria and ASsessment Office, Air Quality Criteria for Lead. EPA, Research Triangle Park, N.C.

settle out in soil close to the road and can be transported by wind or pedestrian traffic and can enter into the house as fine particle lead.[6/]

13. I have reviewed various data regarding soil lead concentrations in and around the City of Boston, including a 1985 report by the City of Boston Department of Health and Hospitals Office of Environmental Affairs entitled Boston Child Lead Poisoning: Request for Immediate Clean-up of Lead Contaminated Soil in Emergency Areas ("Boston Lead-in-Soil Report"). The Boston Lead-in-Soil Report identified 28 residential areas in Dorchester, Mattapan, Roxbury and Jamaica Plain, each averaging two to three blocks, which had disproportionately high numbers of children with elevated blood lead levels and were lead-in-soil "hot spots." The report states that soil samples collected by the city revealed that the average soil lead level was 2,000

[6/] In fact, reports examining the relationship of interior and exterior dust show that interior dust loading is primarily a function of exterior lead levels. See e.g., Fergurson, J.E. (1986), "Lead: Petrol Lead in the Environment and its Contribution to Human Blood Lead Levels," Sci. Total Environ. 50:1-54.

ppm at the homes of the children with elevated blood lead levels was 2,000 ppm. Monica Santiago's former residence at 20 Leston Street is located in one of these identified lead-in-soil hot spots.

14. I have reviewed data regarding the amount of leaded gasoline consumed in Massachusetts and, specifically, in the City of Boston, for various years, including the early 1970's. I have also reviewed data on Boston area traffic patterns during the 1970's, including traffic data for the Mattapan, Roxbury, Jamaica Plain and Dorchester neighborhoods.

15. Based on these data, I have been able to estimate the amount of lead emitted into the Boston area from the combustion of leaded gasoline, including the amount of lead emitted into the area near the intersection of Blue Hill Avenue and Morton Street in Mattapan. I understand that this intersection is located approximately one block from Monica Santiago's former residence at 20 Leston Street.

16. For the years 1972 to 1978, I have estimated that approximately five tons of fine particulate lead was emitted along the 0.4 mile

section of Blue Hill Avenue at the intersection of Morton Street. In addition, the traffic flow along Morton Street and other local traffic routes would have contributed an additional amount of lead in the area of Monica Santiago's former residence. The above estimates assumed a steady flow of traffic. The stop and start nature of the traffic at the Blue Hill Avenue/Morton Street intersection would add to the amount of lead emissions in that area. Thus, the total lead emissions from the combustion of leaded gasoline in this area for these six years would have been more than five tons.[7/] The emission of lead from automobiles in this community is similar to, or even greater than, the emission of lead from a smelter.

[7/] While the largest and most significant source of lead in ambient air in the United States since the 1920's has been from the combustion of leaded gasoline, there are other sources which can contribute to soil lead levels. These sources include: emissions from various metal mining, refining, smelting, and manufacturing operations, combustion of oil, coal, solid wastes and household refuse, emissions from alkyl lead manufacturers; lead battery manufacturers and recyclers; Portland cement production; and the weathering or deterioration of surfaces painted with lead-based paint.

17. The identification of the Leston Street area as a part of a lead-in-soil hot spot is consistent with the research which has shown that urban soil lead levels are related to traffic patterns and city size and not necessarily to the presence of exterior lead-based paint on housing.

18. I have been provided with the results of lead analysis performed on soil samples collected from the yard area at 20 Leston Street. These results confirm the continued existence of high soil lead levels at that address in areas accessible to children and are consistent with the traffic flow and leaded gasoline consumption data for that area. The samples taken from each side of the house (4-6 feet out from the building) had soil lead levels of 1290 ppm and 1400 ppm. The samples collected from the back yard area had soil lead levels of 1060 ppm and 2060 ppm. The two samples taken from in front of the house (from areas near trees) had lead levels of 740 ppm and 380 ppm. Because lead in soil does not appreciably dissipate over time, these current soil lead levels are consistent with the soil lead levels likely to have been present in the 1970's. Street,

curbside, and interior dust and air lead levels, however, were likely to have been greater during the 1970's during the peak use of leaded gasoline.

19. In recent years, the medical and scientific communities have identified the ingestion of lead-contaminated soil and dust as the principal pathway of lead exposure for young children.[8/] The normal hand-to-mouth activity associated with early childhood development presents the most significant pathway of exposure through the inadvertent ingestion of lead-contaminated soils and dusts that adhere to the hands and fingers of children. Young children, as part of their normal development mouth and suck on fingers, toys and other objects which can become covered with lead-contaminated soil and dust.

20. Given my review of relevant data, it is my opinion, to a reasonable scientific certainty, that lead emitted from the combustion of leaded gasoline was a significant contributing source of lead to the soil and dust in and around the property located at

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[8/] See e.g., ATSDR (Agency for Toxic Substances and Disease Registry) 1988, The Nature and Extent of Lead Poisoning in Children in the United States: A Report to Congress, U.S. Public Health Service, Atlanta; CDC (Center for Disease Control) 1985, Preventing Lead Poisoning in Young Children. U.S. Public Health Service, Atlanta, Georgia.

20 Leston Street. It is also my opinion, to a reasonable scientific certainty, that given: (a) the data regarding the soil lead levels in and around the 20 Leston Street property; (b) Monica Santiago's lack of a documented history of pica; (c) the lack of any x-ray examination confirming the actual ingestion of paint chips; (d) Monica's parents have no recollection of seeing Monica put paint chips in her mouth; and (e) the seasonal variations in her blood lead levels, the lead in the soil and dust in and around 20 Leston Street was a significant contributing source of Monica Santiago's lead exposure. Due to automobile emissions major urban areas, such as the City of Boston, have been found to have soil and dust lead levels approaching or exceeding the levels found in communities adjacent to lead smelters, and therefore, the lead in soil and dust that would have been present in and around 20 Leston Street during the early 1970's should have been considered as a significant source of Monica Santiago's lead exposure. It is my opinion that Doctors Silbergeld, Graef, Landrigan and Needleman did not give adequate consideration to this alternative source.

Executed under the penalties of perjury this 12th day of September, 1991 in New Orleans, Louisiana.

Howard W. Mielke, Ph.D.

PERSONAL RESUME

HOWARD WALTER MIELKE

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PERSONAL DATA

Born February 7, 1941 in St. Paul Minnesota. U.S. citizen. Traveled to Africa, Greece, North America, Central and South America, Europe, Soviet Union, Central Asia, Mauritius (Indian Ocean), and Japan.

EDUCATION

B.A. in biology, Macalester College (1963)
M.S. in biology, University of Michigan (1967)
Ph.D. in geography, University of Michigan (1972)
Dissertation title: "Environmental Effects of Airborne Materials from a Cement Plant in Southeastern Michigan."

CHRONOLOGY OF EMPLOYMENT

9/88 to present	Associate Professor, Xavier University of Louisiana, College of Pharmacy, New Orleans, Louisiana.
6/86 to 7/88	Research Associate with the Center for Urban and Regional Affairs, Hubert H. Humphrey Center, University of Minnesota, Minneapolis, MN.
9/85 to 5/86	Visiting Research Scientist, Macalester College, Saint Paul, MN.
1984 to 1985	Advisor to the Student Project for Amity among Nations (SPAN) Malawi Program, University of Minnesota.
9/79 to 8/85	Assistant Professor of geography and environmental studies, Macalester College, Saint Paul, MN.
1/79 to 7/79	Senior Researcher, Maryland Environmental Service/USDA, Waste Management Laboratory, Beltsville, MD; Baltimore urban garden project sponsored in conjunction with an Extension Service

1975 to 1976	Summer Faculty Fellow, Earth Resources Division, NASA Goddard Space Flight Center, Greenbelt, MD.
9/73 to 3/78	Assistant Professor of geography, biogeography and climatology, University of Maryland Baltimore County, Baltimore, MD.
7/71 to 6/73	University of California, Los Angeles: Adjunct Assistant Professor of geography in the Man and the Earth's Ecosystem Program and biogeography.
1/66 to 6/66	Secondary school teacher of biology and English, Anatolia College, Thessaloniki, Greece.
9/63 to 12/65	U.S. Peace Corps volunteer and teacher at Likuni Boys Secondary School, Lilongwe, Malawi, Africa.

PROFESSIONAL SOCIETY MEMBERSHIP AND ACTIVITIES:

Member of the American Association for the Advancement of Science since 1972.

Member of the Society for Environmental Geochemistry and Health since 1979.

International Soil Lead Task Force Member 1988-1990.

Member of the Association of American Geographers since 1972.

Biogeography Specialty Group & Medical Geography Specialty Group.

PROFESSIONAL PUBLICATIONS

BOOKS & MONOGRAPHS

1989 Mielke, H.W. Patterns of Life. Unwin & Hyman, London (UK), Wellington (NEW ZEALAND), Sidney (AUSTRALIA), and Winchester, MA (US). 1989.

1989 Mielke, H.W. and J.L. Adams. Environmental Lead Risk in the Twin Cities. Monograph published by the Center for Urban and Regional Affairs, Hubert H. Humphrey Center, University of Minnesota, Minneapolis, MN 55455.

JOURNAL ARTICLES

Submitted "The Pattern of Cadmium in the Environment of Five Minnesota Cities," H.W. Mielke, V.C. [illegible]

1989 "Speciation, Mobility, and Bioavailability of Soil Lead," Chaney, R.L., H.W. Mielke, and Sterrett, S.B. Environmental Geochemistry and Health 3 (Supplement): 105-129.

1989 "Soil-dust Lead and Childhood Lead Exposure as a Function of City Size and Community Traffic Flow: The Case for Lead Contaminated Soil Abatement in Minnesota," Mielke, H.W., Adams, J.L., R.L. Reagan, and P.W. Mielke, Jr., Environmental Geochemistry and Health 9 (Supplement): 253-271.

1986 "Standards for Soil Lead Limitations in the United States," Chaney, R.L. and H.W. Mielke. Trace Substances in Environmental Health 20: 357-377 .

1984-85 "Urban Lead in Minnesota: Soil Transect Results of Four Cities," Mielke, H.W., S. Burroughs, R. Wade, T. Yarrow and P.W. Mielke, Jr. Minnesota Academy of Science 50 (1): 19-24.

1984 "Urban Lead Levels in Minneapolis: The Case of the Hmong Children," Mielke, H.W., B. Blake, S. Burroughs and N. Hassinger, Environmental Research 34: 54-76.

1983 "Lead Concentrations in Inner-City Soils as a Factor in the Child Lead Problem," Mielke, H.W., J.C. Anderson, K.J.Berry, P.W. Mielke, Jr., R.L. Chaney and M. Leech, American Journal of Public Health 73 (12): 1366-1369.

1982 "Termite Mounds and Chitemene Agriculture: A Statistical Analysis of Their Association in South-Western Tanzania," Mielke, H.W., and P.W. Mielke Jr., Journal of Biogeography 9:499-504.

1978 "Termitaria and Shifting Cultivation: The Dynamic Role of the Termite in Soils of Tropical Wet-Dry Africa," Mielke, H.W., International Journal of Tropical Ecology 19 (1): 117-122.

1977 "Mound Building by Pocket Gophers (Geomyidae): Their Impact on Soils and Vegetation of North America," Mielke, H.W., and P.W. Mielke, Jr., Journal of Biogeography 4 (1): 171-180.

1970 "Geobotanical Distances in New Zealand and Neighboring Islands," Tobler W.R., H.W. Mielke, and T.R. Detwyler, Bioscience 20 (9): 537-542.

ABSTRACTS

1988 Mielke, H.W. "Childhood Lead Exposure as a Function of City-size and Urban Geography." Journal of the Minnesota Academy of Science. 53 [illegible].

1983 Mielke, H.W., "Lead Concentrations in Urban Soil: Identification and Management." Health Effects of Lead in the Environment, pp. 8-9. Freshwater Society, Navarre, MN.

1980 Mielke, H.W., "Soil Lead as a Function of Urbanization." International Geography Vol. I: 310-311. Tokyo, Japan.

[illegible] Mielke, H.W., Biogeochemistry of Serpentine Soils of Soldiers Delight, Maryland, USA: an Inquiry into Soil Processes and Anomalous Flora", International Geography, Section 5, pp. 137-139. Moscow, USSR.

1972 Mielke, H.W., "Fossorial Rodents and the Economics of Soil Gathering Activities." in W.P. Adams and F.M. Helleiner (eds.), International Geography, pp. 314-315. University of Toronto Press.

FILM & PHOTO CREDITS

1988 Malawi in Pictures. Thomas O'Toole (ed). Lerner Publications Co., Minneapolis, MN

[illegible] Earth: an Interplanetary Perspective, Mielke, H.W., W.H. Bryant and F.S. Lane (co-producers). Eighteen-minute educational film distributed by Oxford-Paramount Films, Hollywood, California. Reviewed by M. Breedlove, May 1975. Journal of Geography, pp. 306-308.

SYMPOSIUM AND RESEARCH REPORTS

1988 Mielke, H.W., and Pratema Ghura. "Lead Contamination of Mauritius: Potential Risk to Children", Presented at a UN conference on the Environment in Port Louis, Mauritius.

1984 Chaney, R.L., S.B. Sterrett, H.W. Mielke, "The Potential for Heavy Metal Exposure from Urban Gardens and Soils." in J.R. Preer (ed.), Proceedings of the Symposium on Heavy Metals in Urban Gardens, pp. 37-64. University of the [illegible]

1982 Mielke, H.W., "The Application of Landsat, Geochemical and Photogeographical Methods to Mineral Exploration in Vegetated Regions." In S.F. Richason Jr. (ed.), Pecora VII Symposium Remote Sensing: An Input to Geographic Information Systems in the 1980's, pp. 144-162. American Society of Photogrammetry, Falls Church, Virginia.

1980 Mielke, H.W., "Mapping the Distribution of Potential Serpentine Sites of the Appalachian Piedmont With Landsat." Research Document. Goddard Space Flight Center, NASA, Greenbelt, Maryland.

1987 Mielke, H.W., "Children at Risk: Environmental Assessment of Lead Levels in Saint Paul Parks and Neighborhoods." Report prepared for the City Council of St. Paul, November.

SELECTED PROFESSIONAL PRESENTATIONS AND ACTIVITIES

1989 "Environmental Lead Risk Map: Its Empirical Basis and Development." Invited presentation to an Environmental Data Base Workshop in conjunction with the 4th Environmental Health Conference. June 19, 1989. San Antonio, TX.

1988 to 1989 Member of the IEGH International Soil Lead Task Force that has been assembled for the purpose of recommending procedures for determining a soil lead guideline for the western nations.

1986 Reviewer of the Manual for the Identification and Abatement of Environmental Lead by Lawrence Chadzynski. June. Published in collaboration with the Division of Maternal and Child Health, Department of Health and Human Services, Washington D.C.

1985 "Lead Concentrations in Urban Soil: Identification and Management." Invited presentation to a conference entitled Health Effects of Lead in the Environment, organized by Freshwater Society/Foundation and health, medical and state agencies of Minnesota. University of Minnesota, Saint Paul, Minnesota, May 31.

1985 "Environmental Epidemiology of Lead." Invited presentation at a conference entitled Current Issues of Pediatric Lead Poisoning, organized by the Chicago Department of Health and co-sponsored by the March of Dimes, Chicago, Illinois, May 3.

1984 "Leaded Gasoline as a Factor in the Urban Lead Problem." Testimony before the Committee on Environment and Public Works, U.S. Senate, Washington D.C., June 22.

1980 "Application of Landsat to the Inventory of Regional Resources." Twenty-Fourth International Geographic Congress. IGU/United Nations University Panel on the Use and Management of Natural Resources, Tokyo, Japan, September 3.

1980 "Implications of Remote Sensing on the Transformation of Rural Environments." IGU Symposium: Transformation of Rural Environments, Okayama, Japan, August 27.

1978 "Update on Heavy Metals in the Soil--Recent Findings in Metropolitan Baltimore." Urban Gardening Program Conference sponsored by the Northeast Extension Service of the USDA, Boston, Massachusetts, April 3.

1976 "Biogeochemistry of Serpentine Soils of Soldiers Delight, Maryland: An Inquiry into Soil Processes and Anomalous Flora." Twenty-Third International Geographic Congress, Moscow, Russia, USSR, August 23.

1972 "Zinc and Lead: Urban Contamination and Pathways of Ingestion." Sixty-Eighth Annual Meeting of the AAG, Kansas City, Missouri, April 23.

1971 "An Approach to Solving Cultural-Environmental Problems in the Community." Public Issues Forum, An interdisciplinary study group University of California, Los Angeles, California, December 2.

RECENT GRANTS AND AWARDS

$65,000 grant from the Louisiana Education Quality Support Fund for an urban toxic assessment and mapping project in New Orleans, LA.

$100,000 grant from the Legislative Commission on Minnesota Resources. Awarded to Howard W. Mielke during October, 1988 for a demonstration cleanup project in Inner-city Minneapolis to be commenced July 1, 1989. Project undertaken by Lead Free Kids, Inc.

$8,000 grant from the City of Saint Paul toward mapping the lead levels of play areas of Saint Paul. Passed by resolution by the Saint Paul City Council, May 29.

$34,000 grant from the Saint Paul Foundation for research on lead levels in play areas of Saint Paul communities. Yearly matching grants from June 1984 to June 1988.

National Science Foundation College Science Instrumentation Grant for a project entitled "Weather Satellite Connection and Video Facsimile Display System." Awarded June 1, 1985.

Citation for Maritorious Contribution from Governor Rudy Perpich for assisting the Minnesota Department of Health with the lead project. Awarded 1985.

REFERENCES

Supplied upon request.