Forthcoming in: *No Child Left Different: How America's Lost Tolerance Has Led to Psychiatric Overdiagnosis and Overmedication of Kids*

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# Toxic World/Troubled Minds

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Port Huron, Michigan, sits just across the Blue Water Bridge from Sarnia, Ontario. The St. Clair River flows between them, carrying the waters of the Great Lakes of Michigan, Superior, and Huron south. From Sarnia and Port Huron past the recreational shores of Lake St. Clair to the industrialized southern reaches of Detroit, the St. Clair water system picks up the wastes of one of the most highly industrialized regions of the world. Eventually it discharges these into Lake Erie just north of Toledo, Ohio. One of the largest installations of petrochemical plants on the continent, Sarnia hosts, among many others, Suncor Energy, Imperial Oil (Exxon), Shell, DuPont, and Dow Chemical. Twenty of its plants produce daily emissions that are large enough that they must be reported to Environment Canada's national registry of pollution releases. In the 1980s the so-called Sarnia Blob of toxic chemicals was discovered in the St. Clair River, and the river is one of the sites where federal scientists have found wildlife with blurred sexual characteristics. Just as Illinois, Indiana, and Ohio send their toxic airborne fuel emissions north and east to cover a territory that ranges from Windsor to Quebec

City, sometimes for weeks at a time, gagging Toronto, Ottawa, and Montreal as well, so Sarnia sends its harsh, concentrated pollution south, down the river to the United States. Pollution doesn't recognize borders.

On the Aamjiwnaang First Nations Reserve just south of Sarnia, literally in the midst of those petrochemical installations, children play on lawns and suburban streets. Yet less than one hundred yards away at the plants, the workers have dressed for some years in biohazard suits. And in recent years the community has begun to figure out why: the births of girls outnumber the births of boys two to one, and the ratio continues to worsen; women have been reporting multiple miscarriages; and many children are having problems with normal sexual development. As in other jurisdictions, these frightening problems have gone hand in hand with an equally frightening phenomenon: a striking rise in the number of children with problems of neurological development and mental health. Large numbers of children at the local elementary school have below-average intelligence, developmental delays, learning deficits, and behavioral problems.[1]

Living in the shadow of a toxic industry may be a worst-case situation, but it would be a mistake to believe that anyone not surrounded by chemical plants or directly living in their plumes is out of harm's way. Scientific investigations have repeatedly shown us that, through many forms of dispersal, the persistent organic pollutants (POPs) these plants produce have been carried to the remotest places on earth and that we all carry them in our bloodstreams. Science has also demonstrated that extremely low levels of these toxicants can cause significant, lifelong damage to children's sexual, neurological, and immunological development; the damage is especially problematic when they affect fetuses, infants, and toddlers.

Many scholars and commentators have been pointing out for years that growing numbers of American children are failing to thrive. In the wealthiest country on earth, we are witnessing yearly increases in youth violence, emotional volatility, depression and even suicide, substance abuse, and plummeting educational achievement.[2] Along with "emotional" problems—volatility, anxiety, panic, depression, suicide—we're witnessing an epidemic of neurodevelopmental disorders. These include learning disabilities, dyslexia, mental retardation, attention-deficit disorders, and autism, and they now affect 5–15 percent of the 4 million babies born in the United States each year. Without question many sociocultural factors are contributing to this troubling state of affairs. This article sheds additional light on the role of environmental toxins and, in the briefest of terms, points toward some solutions.

Over 85,000 synthetic chemical compounds are now registered for commercial use in the EPA's Toxic Substances Control Act (TSCA) inventory, and 2,800 high-production-volume (HPV) chemicals are currently produced in quantities of 1 million pounds or more per year. Arguably, not one has ever been properly tested for its toxicity—because none has undergone transgenerational studies on humans. But even at a less demanding level, hundreds have not been tested for potential toxicity to humans, and most—80 percent—have not been tested for toxicity to children.[3] This failure to test for safety in children is crucial, because in utero and early life exposures to lead, mercury, polychlorinated biphenyls (PCBs), certain pesticides, and other environmental neurotoxicants are known by many epidemiologists and toxicologists to contribute to the causation of very serious conditions. A report from the U.S. National Research Council concluded that 3 percent of developmental disabilities are the direct consequence of

neurotoxic environmental exposures and that another 25 percent arise out of the interplay of environmental factors and individual genetic susceptibility.[4] (Note that without the "environmental factors," the genetic susceptibility would not be triggered—so finally this too is reducible to pollution, not genetics.) The NRC, like virtually every institution and researcher in the field, notes that the poor are particularly at risk.

This chapter focuses on three environmental toxins that are widely known to compromise children's neurological development and mental health: lead, mercury, and a class of toxins known as persistent organic pollutants (POPs). But first we explore how children come into contact with environmental toxins and why they are so much more vulnerable to their effects than are adults.

One caveat is crucial at the outset, however. Set aside are the huge health implications for children of the sex-hormone-disrupting effects of POPs—the chemicals so often seen in connection with neurological harm. Also left aside are the industrial uses of synthetic hormones and antibiotics in agriculture and environmental problems such as global warming, extreme weather, water shortages, and other various and pressing environmental challenges. Nevertheless, it is important to understand that all serious environmental health impacts have a bearing on mental functioning and emotional health—and may indeed lead to the inappropriate psychotropic drugging of children. For example, children whose homes and schools are contaminated with toxic mold as a result of damage from severe weather, such as ice storms or hurricanes, are children at risk for poor academic performance and depression due to the effect of mold on the immune and nervous systems. Children who are the victims of precocious puberty (girls) or retarded sexual development (boys), problems to which POPs contribute, are at great risk for

emotional problems.[5] By the same token, petroleum-based artificial food additives and dyes now ubiquitous in processed foods have been shown repeatedly to provoke extreme reactions in a great many children, ranging from inability to sit still or to write, to storms of temper and other forms of distressed and distressing behavior. Large numbers of such children have been drugged and therapized repeatedly and without success. But where a parent or physician, or indeed a school principal or school board, thought to eliminate the additives from the food, recovery for many children has been very significant, sometimes complete.[6]

## TOXIC WORLD, BODY BURDEN

How do our children come into contact with chemical environmental hazards? First, let's note that such hazards are virtually everywhere. It is not possible to catalogue the whole picture, but we can use a study of Colorado's water, reported in January 2005, to get an idea. In that state, scientists working for the U.S. Geological Survey reported that by-products of everyday activities such as antibacterial hand soap or bug spray are winding up in streams and groundwater that reach from the Denver area to remote spots in the Colorado mountains. Bill Battaglin, a coauthor of the study, said scientists expected to find chemicals associated with detergents, disinfectants, and pesticides in urban waterways but were surprised to find some of them in more remote areas. Fire retardants, caffeine, steroids, prescription drugs, and a host of insecticides and pesticides were all found in the waterways. Some of the compounds were found in rural water wells, although in fewer numbers and lower concentrations than in urban areas. Possible sources, the study suggested, include feed lots, industrial sites, wastewater treatment plants, septic systems, and water runoff.

Some of the chemicals documented in the U.S. Geological Survey, according to the scientists, are suspected of disrupting fish reproduction and of increasing resistance to antibiotics. The compounds that are regulated were within limits deemed safe, but—and here is the crucial problem—no standards exist for most of the sixty-two chemicals. In a similar study done of Minnesota waters, seventy-eight chemicals were found, and many of these too were associated with disruptions to the physical and sexual health of wildlife. The Colorado Department of Public Health and Environment responded that it was closely tracking the findings. "The ubiquitous nature of the chemicals was a bit surprising, but I guess nobody's looked that closely before," the director of Colorado's water quality division told Associated Press reporter Judith Kohler. Determining the potential long-term effects of the chemicals and their sources, and figuring out how to reduce them, perhaps through more advanced wastewater treatment, likely would take several years and several million dollars, he added.[7]

The Colorado and Minnesota studies are all too typical. Indeed, the Environmental Protection Agency (EPA) has issued advisories for mercury, dioxins, PCBs, and other persistent organic pollutants for more than one-third of U.S. lakes and nearly one-quarter of its rivers. In 2004 EPA officials said people should severely limit consumption of fish caught recreationally. Many studies over the last fifteen years have shown very high levels of multiple persistent chemical and agricultural contaminants in vast tracts of waterways, and in much soil and air besides. These chemicals have been found nearly everywhere studies have been done on North American air, soil, and water. In January 2005, the *Toronto Globe and Mail* released the results of a specially

commissioned study on PBDEs (flame retardants), which found them not only in soil and water but also in food, household carpets, and dust bunnies under beds.[8]

Since these chemicals are found in the water, air, and soil, it should not surprise us that a high "body burden" of toxicants has been found inside us too. In November 2004, the European Public Health Alliance (EPHA) reported on a major study that found a "toxic cocktail" in human *blood*. This "cocktail" was flowing in the veins of every one of the 155 volunteers from different parts of the United Kingdom who participated in a scientific study. The subjects were tested, and showed positive, for a host of sex-disrupting PCBs, flame retardants, and organophosphates (pesticides)—the same chemicals that show up in American waterways. The study focused on seventy-seven chemicals known to be "very persistent" in the environment and to accumulate in people's bodies. It was among the most comprehensive of studies done to date. Just how persistent these chemicals are—and this is among the very greatest concerns for children and future generations—was demonstrated by the fact that 99 percent of the people tested had breakdown products of the pesticide DDT in their blood, even though this pesticide was banned more than thirty years ago in the United Kingdom and Europe. Worse, the blood levels of most of the chemicals were comparable to those found in people exposed to chemicals through their work. And finally, women were found to have lower levels of certain PCBs than men. These *levels were lowest in women who had carried and breastfed more children*, prompting the researchers to speculate in support of a thesis advanced more than ten years ago by U.S. scientists, Theo Colborn among them (*Our Stolen Future*), that this might demonstrate the "off-loading" of chemicals in the women's bodies to their offspring.[9]

Last fall, similar results were obtained from testing the blood of the environment ministers from thirteen European Union countries—Britain, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Hungary, Italy, Lithuania, Slovakia, Spain, and Sweden. Their blood was contaminated with a mix of the usual suspects. All the ministers bore traces of twenty-two PCBs, toxic chemicals banned in Europe during the 1970s and among the "dirty dozen" being phased out internationally. The WWF (formerly known as the World Wildlife Fund), which sponsored the test, said that we do not have enough public safety information about 86 percent of the 2,500 industrial chemicals most commonly used, even though research has linked many of them to cancers, allergies, reproductive problems, and neurological and growth defects. A total of fifty-five different chemicals was found in the ministers' blood. The most highly concentrated chemicals found across the sample were the phthalate additive (used to soften plastics, including babies' toys and pacifiers, and known as one of the pseudo-estrogen chemicals) and the DDT toxin.[10]

John Spengler at Harvard's School of Public Health is one of those in the United States working in the new field of body burden, the emerging science of chemicals that accumulate in the human body. His work and that of other Harvard colleagues show results similar to the studies done by the Europeans.[11] For if the chemicals are in the water, the air, the food, and the furniture, if their spread knows no countries or borders, it is unavoidable that they'll be in the blood and tissues of the inhabitants of North American too.

It should come as no surprise, then, that groups such as Boston Physicians for Social Responsibility want to alert the public to the dangers and the damage of

environmental toxicants to children. Their report, *In Harm's Way*, presents a number of key findings:

- An epidemic of developmental, learning, and behavioral disabilities has become evident among children.
- Animal and human studies demonstrate that many chemicals commonly encountered in industry and the home are developmental neurotoxicants that can contribute to developmental, learning, and behavioral disabilities.
- Recent research has produced a glut of information not readily understood by nonspecialists.
- Genetic factors are important, but particular vulnerability to toxic chemicals may be the result of a single gene or multiple-interacting genes.
- Neurotoxicants are *not merely a potential threat* to children.
- Vast quantities of neurotoxic chemicals are released into the environment each year.
- As scientific knowledge advances, the "safe thresholds" for known neurotoxicants have continuously been revised down.
- Protecting our children requires a precautionary policy that can only occur with basic changes in the regulatory process.[12]

## WHY CHILDREN ARE UNIQUELY VULNERABLE

Until recently, regulatory agencies set acceptable tolerances for the safety of industrial chemicals based on their apparent effects on adults—usually males—and with a focus on whether or not the chemicals were carcinogenic. Now we know that men and women have different tolerances for different kinds of chemicals; we know that the effects of toxins may not show up for decades or until the next generation; and we know

that there are many other diseases besides cancer that are caused by environmental poisons. But most compellingly, we now know fetuses, infants, and children *do not respond to environmental hazards as though they were small adults*. In fact, they are much more vulnerable than adults in ways that are qualitatively different and have consequences for their whole lives. In the words of the Children's Environmental Health Network (CEHN), "the elegance and delicacy of the development of a human being from conception through adolescence affords particular windows of vulnerability to environmental hazards. Exposure at those moments of vulnerability can lead to permanent and irreversible damage."[13]

The implications of this fact are simple: *when we pollute our environment, we place the greatest burden on our children*—a finding now well documented.[14] The following factors, a list drawn from several authoritative sources, explain why children are so vulnerable:[15]

- Fetuses in the womb are physically unable to process or defend against serious toxicants because their nervous, respiratory, reproductive, and immune systems are far from fully developed, and they are in the process of dynamic change.
- Fetuses may be grievously, even irreversibly, harmed by toxins arriving via the placenta. Toxins most known to cause harm to the nervous system are lead, PCBs, mercury, ethanol, PBDEs, and nicotine from tobacco smoke in the environment.
- In their first year, babies spend hours close to the ground, where they may be exposed to toxicants in dust, soil, and carpets as well as to pesticide vapors in low-lying layers of air on lawns and porches. For the first few years of children's lives, even after they

learn to walk, stature and play patterns keep them much closer to the ground—where toxicants are concentrated.

- These chemicals mimic the body's hormones and have been shown to disrupt reproductive and hormone systems in wildlife, including thyroid hormones crucial to neurological development, and are implicated in similar disruptions during human fetal and early childhood development.
- Children have higher metabolic rates and a higher proportionate intake of food and liquid than do adults. Their cells are multiplying and their organ systems are developing at a very rapid rate.
- Children absorb nutrients and toxicants from the gut at different rates. Children need more calcium than adults, for example. But when lead is present, they will absorb it in preference to calcium. So adults will absorb an average of 10 percent of ingested lead, but a toddler will absorb closer to 50 percent.
- Developing metabolic systems in children are much less capable of detoxifying and excreting toxins than are those of adults—hence buildup is greater, and greater per unit of body weight.
- A lot of hand-to-mouth exposure is a normal part of childhood and provides another route for exposure to such toxicants as lead in paint dust and pesticide residues. Recently, mercury has been found in soil as well as water.
- Children breathe more rapidly and respire more air per unit of body weight than do adults, and they often spend more time outdoors. Their developing respiratory systems and greater exposure mean they are at risk for even greater adverse effects—such as childhood asthma, for example—due to air particulates, ozone, and other

outdoor pollutants. Recent research has also shown that tiny particulates of air pollution penetrate the blood/brain barrier (also weaker in children) and affect the brain as well as the lungs and the circulatory system.

- Children eat more fruits and vegetables and drink more liquids in proportion to their body weight than do adults. Consequently, their potential exposure to ingested toxicants such as lead, pesticides, and nitrates is greater. Consider that the average infant's daily consumption of six ounces of formula or breast milk per kilogram of body weight is equivalent to an adult male drinking fifty eight-ounce glasses of milk a day. The average one-year-old eats two to seven times more grapes, bananas, pears, carrots, and broccoli proportionally than does an adult.
- Exposure to toxicants at an earlier age means children have more time to develop environmentally triggered diseases with long latency periods, such as cancer and possibly Parkinson's disease, but also allergies, autoimmune disorders, and chemical sensitivities, and, of course, mental and emotional disorders.

These factors set the backdrop for the particularly devastating effects of a host of chemicals and heavy metals on fetuses and children. In the sections that follow we focus on lead, mercury, and a number of POPs, leaving aside, due to space limitations, a large number of other chemicals now doing harm to children. Perhaps this brief catalogue can inspire readers to find out more about these other problems too.

## THE DAMAGE OF HEAVY METALS: LEAD AND MERCURY

It's now well established that exposure to a variety of heavy metals can cause serious problems in fetuses and children. Still, many people, even specialists in health and education, believe that such problems are small in scale or confined to very limited

populations. This misapprehension hinders any attempt to tackle the tremendously damaging effects of these substances.

### Lead

Howard Hu of Harvard University has written a great deal about heavy metals, including lead, in recent years. In 2002, he had this to say about lead:

> The general body of literature on lead toxicity indicates that, depending on the dose, lead exposure in children and adults can cause a wide spectrum of health problems, ranging from convulsions, coma, renal failure, and death at the high end to subtle effects on metabolism and intelligence at the low end of exposures. Children (and developing fetuses) appear to be particularly vulnerable to the neurotoxic effects of lead. A plethora of well-designed prospective epidemiologic studies has convincingly demonstrated that low-level lead exposure in children less than five years of age (with blood lead levels in the 5–25 μg/dL range) results in deficits in intellectual development as manifested by lost intelligence quotient points. As a result, in the U.S., the Centers for Disease Control (CDC) lowered the allowable amount of lead in a child's blood from 25 to 10 μg/dL and recommended universal blood lead screening of all children between the ages of six months and five years. Recent research has clearly demonstrated that maternal bone lead stores are mobilized at an accelerated rate during pregnancy and lactation and are associated with decrements in birth weight, growth rate, and mental development. Since bone lead stores persist for decades, it is possible that lead can remain a threat to fetal health many years after environmental exposure had actually been curtailed.[16]

Herbert L. Needleman, of the University of Pittsburgh's School of Medicine, was responsible for much of the influential research that led the U.S. government to ban lead in fuel in 1979. He was among the early researchers who established that children with elevated lead levels had lower IQs, poor reading skills, and problems paying attention.

His work was important because it showed that problems traditionally defined as genetic or psychogenic could also be the results of simple, if grievously harmful, toxicants.

As well as deficits in intelligence and learning capacities, lead has been linked to disruptive classroom behavior, failure to graduate high school, violent tendencies, addictive predispositions, and other behavioral and emotional problems resulting in self-destructive and criminal behaviors.[17] Studies covering hundreds of communities have shown that those with larger percentages of children with high levels of lead in their blood are significantly more likely to have higher rates of violent crime and higher rates of educational failure. Needleman, a pioneer of such studies, began looking at the possible connections between lead and crime in the 1980s. He studied a sample of 300 seven-year-old boys in primary school, measuring the concentration of lead in their bones; he then looked at these findings against reports of antisocial behavior from the students' teachers, parents, and the children themselves. He retested two years later, and then again when the subjects were eleven years old. A report on his findings notes the following:

> At age 7, parents reported no significant problems associated with lead, but teachers, by contrast, were beginning to spot social problems and delinquent and aggressive behavior. By 11, both parents and teachers of high-lead children were reporting significantly more social problems, delinquent and aggressive behavior, acting out, anxiety and/or depression, and attention problems. High-lead students also reported more delinquent behavior themselves. These behavior problems "went up in direct relation to the lead levels in the bone," Needleman said in an interview. He also found much higher lead rates in a group of juvenile delinquents than in a control group. He used 416 youths—216 delinquents and 200 in a control group. Adjusting for such factors as race, parental education, occupation, family size and crime rate in the neighborhood the

> youths came from, he found those with high lead levels were twice as likely to be delinquent than those with low levels.[18]

Needleman estimates that 11–38 percent of the nation's delinquency is attributable to high lead exposure, a finding he presented at a recent pediatric meeting in Boston. Needleman explains that lead creates biochemical changes that result in lower IQ, an inability to sit still, and problems with language and reading.

Roger D. Masters, a Nelson A. Rockefeller professor of government emeritus at Dartmouth College and president of the Foundation for Neuroscience and Society, who has studied heavy metals such as lead, manganese, and cadmium, has found that heavy metals affect the neurotransmitters. Manganese, for example, has the opposite effect of Prozac. It reduces serotonin. Studies of young delinquents and long-term prison inmates present a biochemical picture that shows how nutritional status, particularly with respect to minerals, differs, and how enzyme deficiencies, possibly genetically determined, predispose some people to accumulate heavy metals.[19]

Although lead is gone from gasoline in developed countries (although not worldwide) and progress is being made toward ridding houses and institutions of old lead-based paint, a new mechanism for lead exposure has arisen. Masters has found a disturbing correlation between high lead rates and the use of silicofluoride to fluoridate water systems in given communities. Among most of the states in which he has measured high lead levels, he has found the levels to be much higher when silicofluoride is in the water. "If you look at violent crime," he has said, "you find the same kind of thing. A kind of doubling of the crime rates where silicofluoride is used. It seems to have the effect of breaking down barriers between the blood and the gut. It appears that silicofluoride increases the amount of toxins that get into the blood." Masters looked at

towns in Massachusetts that had had more than ten toxic spills over a two-year period. If silicofluoride was not in the water, fewer than 1 percent of children had high lead levels. If silicofluoride was in the water, five times as many children had high lead levels.[20]

Nutritional status is very important in cases of lead exposure. Lead and calcium bind to the same place. A child low in calcium will pick up a lot more lead than one with adequate levels. So here, too, poverty, which affects nutritional status, becomes a risk factor for lead poisoning.

### Mercury

"From a global perspective," writes Howard Hu, "mercury has been increasing in importance as a widespread contaminant. About half of the National Priority List toxic waste sites in the U.S. contain mercury. Mercury dispersion through atmospheric deposition has increased markedly through waste incineration; ironically, the medical industry is one of the largest contributors to mercury pollution in this fashion. . . . Fish, particularly tuna, king mackerel, and swordfish, can concentrate methyl mercury at high levels." Although mercury toxicity at any age is a health risk, "of greatest concern on a global scale," writes Hu, "is the sensitivity of the fetal and infant nervous system to low-level mercury toxicity. The 1955 disaster in Minamata Bay, Japan, first alerted researchers to the dangers that mercury can pose to neurological development in the fetus. Women who were victims of this disaster gave birth to infants with mental retardation, retention of primitive reflexes, cerebellar symptoms, and other abnormalities. Recent research in the Faroe Islands has demonstrated that, even at much lower levels, mercury exposure of pregnant women through dietary intake of fish and whale meat, an important regional food staple, is associated with decrements in motor function,

language, memory, and neural transmission in their offspring. Organic mercury, the form of mercury bioconcentrated in fish and whale meat, readily crosses the placenta and appears in breast milk."[21]

A nationwide survey by the U.S. Centers for Disease Control (CDC) found that one in twelve women of childbearing age already have unsafe blood levels of mercury and that as many as 600,000 babies in the United States could be at risk. This number is staggering. Researchers at the Mount Sinai Center for Children's Health and the Environment released a study in March (in the journal *Environmental Health Perspectives*) in which they combined a number of previous studies to determine that hundreds of thousands of babies are born every year with lower IQs associated with mercury exposure. Using work examining the effects of lead exposure on IQ, researchers determined that even a 1.6 point drop in IQ could cost a person $31,800 in lifetime earnings because of missed educational opportunities or jobs. From there, the researchers calculated that mercury damage in the womb probably costs the United States $8.7 billion a year in lost earnings potential. The research found the IQ losses linked to mercury range from one-fifth of an IQ point to as much as twenty-four points.[22]

For some time, some researchers have feared that thimerosal, a mercury derivative used as a preservative in vaccines, was causing autism in children. Other researchers claimed that this was simply not possible. But only a month ago from this writing, a study released by scientists at the University of Texas Health Science Center in San Antonio and to be published in an upcoming edition of the peer-reviewed journal *Health and Place* looked at 254 counties and 1,200 school districts in Texas, comparing 2001 mercury emission levels with rates of autism and special education services.[23] It

reported a strong correlation between higher mercury release levels from coal-burning plants and the developmental disorder marked by communication and social interaction problems. Once thought to occur in 1 of every 10,000 children, autism today is estimated to afflict 1 in 250!

Because mercury is a neurotoxin that affects the brain, spinal cord, kidneys, and liver, it is thought by many to play a part in the etiology of autism. Coal-burning power plants are the largest source of mercury in the United States today—forty-eight tons of the poison annually. Texas plants release more than those in any other state. The researchers found a 17 percent increase in the autism rate for every 1,000 pounds of mercury released into the environment.

It was long thought that methylmercury—the toxic form—was found primarily in water, where bacteria broke it down from plain mercury. But within the last twelve months a veritable flood of information on mercury studies has revealed that toxic mercury is concentrated on land as well, and often in "mercury hot spots"; that it's found in the blood of non-fish-eating birds; and that we do not understand how widespread and bio-available it really is—except that things are considerably worse than previously suspected. A scientist with the Mercury Connections study, which found mercury poisoning in small birds on a Vermont mountaintop, remarked that "this is a wake-up call for us as a species to reflect on how much mercury we are putting in the atmosphere. There's mercury all over the place. The thrush may be a canary in the coal mine."[24]

The amount of progress that has been made in cleaning up this toxicant is a matter of considerable controversy. Certain measures in reducing medical waste incineration have brought about some reductions, but the potential for more coal-burning plants with

inadequate pollution controls is a bleak one. A Harvard study estimated the potential public health benefits from cutting mercury pollution from coal-burning power plants in half fifteen years from now at $5 billion a year. The EPA has estimated that these benefits could be as high as $50 million a year. It's a thought-provoking discrepancy.[25]

## PERSISTENT ORGANIC POLLUTANTS AS NEUROLOGICAL DISRUPTORS

### Solvents

In October 2004, a new study, done at the MotherRisk program of the internationally renowned Hospital for Sick Children in Toronto, showed that children born to mothers exposed to solvents in the workplace had significant developmental delays as a result.[26] (Solvents are chemicals used by hair stylists, medical technologists, scientists, and others.) These children exhibited lower IQs and poorer language skills, and were inattentive and hyperactive. Despite the use of protective equipment such as masks and gloves to minimize their exposure to the chemicals, the mothers were obviously not sufficiently protected from the seventy-eight chemicals involved. Concerns about fetal exposure to workplace toxins have been expressed for decades by pioneers in the environmental field such as Theo Colborn and Doris Rapp. [27] But for a long time these scientists were voices in the wilderness. The MotherRisk research is now part of a growing body of evidence, in animals and in humans, that demonstrates the neurological, mental, and emotional health risks of exposure to such solvents.

## Pesticides

In June 2004, Pesticide Action Network North America (PANNA), based in Washington, DC, released its report, *Chemical Trespass: Pesticides in Our Bodies and Corporate Accountability*. For the first time PANNA made public an analysis of pesticide-related data collected by the U.S. Centers for Disease Control and Prevention (CDC) that measured levels of chemicals in 9,282 people nationwide. The PANNA research demonstrated that the body burden of toxic pesticides that U.S. residents carry is far above government-assessed "acceptable" levels. PANNA noted that many of the pesticides found in the test subjects have been linked to serious short- and long-term health effects, including infertility, birth defects, and childhood and adult cancers.

The analysis found that children first, followed by women and Mexican Americans, shoulder the heaviest "pesticide body burden." Of particular concern were the findings that children have been exposed to the highest levels of nerve-damaging organophosphates. The PANNA analysis of the CDC data revealed that six- to eleven-year-olds in the subject pool had been exposed to the organophosphate pesticide chlorpyrifos (commonly known by the product name Dursban) at four times the level the EPA considers "acceptable" for long-term exposure.

Similar results were reported by the Ontario College of Family Physicians, which published a comprehensive study in 2004 on the chronic effects of pesticide exposure in the home, the garden, and at work. The study found links between common household pesticides and fetal defects, neurological damage, and the most deadly cancers. The college instructed its members to urge citizens to avoid pesticide exposure in any form. The study also found consistent links between parents' exposure to certain agricultural

pesticides at their jobs and increasing fetal damage or death. The risks, they concluded, can come even from residue on food, ant spray, and the flea collar on the family pet. Their findings were supported by the Canadian Cancer Society, the Learning Disabilities Association of Canada, the Registered Nurses Association of Canada, and the Ontario Public Health Association, all of whom have called for the bans as well.[28]

There is compelling evidence, based on animal studies, that organophosphates, carbamates, and organochlorine pesticides cause neurobehavioral damage, but to date there is a paucity of research on children. As reported by Charles W. Schmidt in *Environmental Health Perspectives*, Elizabeth Guillette, an anthropologist and adjunct professor in the Bureau of Applied Research in Anthropology at the University of Arizona in Tucson, has gathered evidence as part of a battery of developmental end points in a study of indigenous children living in the Yaqui Valley of northwestern Mexico. According to Guillette, "the results of a simple test show[ed] that young children exposed to pesticides were practically unable to draw a simple picture of a person. . . . The random undifferentiated lines drawn by exposed children averaged only 1.6 body parts per figure, whereas nonexposed children produced reasonably lifelike figures averaging 4.4 body parts each." For Schmidt, these results "provided one of the most compelling illustrations to date of a possible neuro-developmental effect of pesticides in children."[29] This research replicates the findings of Doris Rapp, who in *Is This Your Child?* has published drawings made by children she tested. Also according to her research, children exposed to the pesticides showed a decrease in stamina and thirty-minute memory, and a loss of gross and fine eye-hand coordination.[30]

The greatest challenge at present is that virtually all the toxic chemicals classed as persistent organic pollutants were passed into manufacture without the kind of testing we now know is needed to determine their real effects, particularly on fetuses and young children. At the same time, the length and the demanding protocols of scientific research mean that retrospective investigations are very slow and not adequate to the task at hand—that of identifying safe levels of exposure to any given chemical.

## CONCLUSION

Problems with the neurological development of children that have been identified so far as related to toxicants can be grouped as follows: lowered concentration and information processing power; reduction in the ability to handle stress, hence an increase in frustration, volatility, and failure; an increase in depression, hence a greater predisposition to violence, addiction, and criminal behavior; and finally, a deleterious effect on the development of intelligence per se. A five-point drop in mean population IQ is estimated to reduce by half the number of gifted children (IQ over 120) and increase by half the number with borderline IQ (below 80).[31] Talk about the "dumbing down" of society!

On an individual basis, a child who is unable to concentrate, to read, or to process complex ideas because of pesticide exposures or heavy metal poisoning will often be diagnosed with attention and learning deficits. In the search for the cause of her problems, the parents may be unfairly targeted as neglectful, or the child may well be given psychotropic medication, often exacerbating the problem or creating new neurological and metabolic challenges. Rather than drugs or psychotherapy, children such as these need detoxification treatment and nutritional remediation.

At the community and societal levels, children who have lowered IQs, learning deficits, or volatile behavior as a result of toxic chemical exposure represent an unconscionable squandering of our social capital and a tragic testament to our cavalier disregard for the well-being of our young. Poor children are most at risk for multiple hazardous environmental exposures as well as for multiple sociocultural risk factors. Their plight testifies to our society's willingness to make poor children pay in the most devastating terms for our affluence.

Finally, what is happening to all the children who are poisoned by our way of life, across class, ethnic, race, and gender lines, threatens the future intelligence (and fertility) of our larger society and represents a major crisis not only in our notions of equality and justice but in our very viability.

If we are to make meaningful headway in addressing these pressing issues, it is essential that researchers and professionals in the fields of environmental epidemiology, biostatistics, occupational health, toxicology, medicine, education, and mental health pool their research and clinical practices to ensure accurate diagnosis and effective treatment of children with mental and emotional disorders. And in order to make the necessary advances in understanding, treating, and preventing the harms this essay has described, we need to act on three broad levels. Before discussing these, however, a word about the political and economic contexts in which we must act.

### Environmental Madness

The problems this chapter chronicles have been in the making for a long time. Some of their origins were laid down during the industrial revolution, but they really began to take root after the explosion of petrochemical use in the 1950s. Like a wave that

starts slowly and then more and more rapidly gains momentum and height as it reaches the shore, these problems have been swelling and accelerating so that we are now facing a veritable tsunami of dangers whose impact on individuals and society is extremely destructive. We have created more than 100,000 chemicals for which neither our biosphere nor our bodies were designed. We have altered our environment so that our water, air, and soil send back the poisons we've dispersed into them; we've flooded the capacity of the earth's natural systems and our own to handle all these pollutants. To turn things around, we must make significant changes, and rapidly. These changes range from shifting our production technologies from toxic to green, to supporting families and communities as they struggle to deal with the results of the fallout of our old technologies close to home.

It is to the credit of countless individuals, organizations, communities, industries, and governments that many positive actions have been taken. Many new technologies have been developed, and many programs have been launched to address the challenges. Still, despite improvements made by committed and caring people everywhere, overall environmental quality continues to decline. A study released last December, for example, based on Canadian government statistics, showed *that air and water pollution have increased by 50 percent over the last seven years*, a finding that shocked and surprised many because of big business's claims that it was on the pollution case. These findings would be equally relevant to the northern United States.[32]

Unlike many countries, especially in the less developed world, the United States has the wealth, the technology, and the expertise in abundance to address the problems this chapter has described. But while many states and municipalities are taking positive

initiatives on a number of fronts, at the federal level this is not happening. In fact, we seem to have an environmentally challenged administration in place today. Between the midterm elections of 2002 and December of 2004, the Bush administration took more 101 rollback initiatives that sought to de-fang or to gut the environmental regulations that were the product of thirty years of legislation. Taking the sum of these initiatives, the League of Conservation Voters cited President Bush and his allies for "consistently siding with corporate interests over the interests of American citizens in a clean and healthy environment."[33]

In April 2005 the Millennium Ecosystem Assessment, the first-ever global inventory of natural resources, was published. The report cost $24 million and took more than 1,300 scientists in ninety-five countries four years to complete. It is backed by the UN, the World Bank, and the World Resources Institute. The assessment reached the overwhelming conclusion that we are living way beyond our environmental means. Approximately 60 percent of the planet's natural products and processes that support life, such as water purification, are being degraded or used unsustainably.[34] Yet the current U.S. administration has resisted placing new limits on pollutants and industrial toxins and has rolled back many existing limits. Even when some limits are put in place, as in the EPA's recent mercury reduction order, the recommendations of industry are followed rather than those of public health professionals, environmentalists, or state governments.[35] And of course because pollution knows no borders, what is generated in the United States is shared—first with North American neighbors and ultimately with the whole world.

It is not possible to believe in an infinitely malleable environment and still put credibility in the environmental reports and alarms raised by scientists in every field, in and out of government, in the United States and globally. And so, as many people have observed with great disquiet, the Bush presidency has simply chosen to ignore science. In February 2004, the Union of Concerned Scientists published a report about the record of the Bush administration with respect to the treatment of scientists, scientific method, and evidence, which rang alarm bells throughout the country and around the world. They found that "there is a well-established pattern of suppression and distortion of scientific findings by high-ranking Bush administration political appointees across numerous federal agencies."[36] And they noted that there is "significant evidence that the scope and scale of the manipulation, suppression, and misrepresentation of science by the Bush administration is unprecedented."

This administration's agenda presents a special challenge to Americans who care about children. But even in Washington, DC, not all is lost; so much is possible at state, municipal, and local levels that there is abundant hope.

## What We Need to Do

If we are to protect children's minds and bodies from toxic pollutants, action is needed by families, communities, and government.

### *Parents*

Books such as Herbert Needleman and Philip Landrigan's *Raising Children Toxic Free: How to Keep Your Child Free From Lead, Asbestos, Pesticides and Environmental Hazards*, and Doris Rapp's *Our Toxic World* provide parents with a wealth of information to help them help their children.[37] They suggest alternatives to toxic

household products, provides help in recognizing the signs and symptoms of environmental illnesses, and details resources in the medical community to assist sick children. But children who are suffering from toxic exposure to environmental pollutants generally require medical interventions that are not part of standard health insurance plans, and this can be costly and daunting. In addition, children who have a high body burden of environmental toxicants often need to eat organic food and to live and go to school in environments in which nontoxic cleaning and construction products are used. These choices are beyond the scope of many families because of financial or time constraints. Clearly then, it is essential that other members of the community, and governments, partner with and support parents' efforts. As well, it must be said that no parent can fully protect a child from ubiquitous toxins that are invisible and inescapable. Hence, individual efforts, while important, simply aren't enough to address these health issues.

### *Community Efforts*

*Educators* have the potential to play a pivotal role in helping to protect children from environmental toxins. Teachers spend several hours a day with their students and have access to parents, on the one hand, and local public authorities and policymakers, on the other. School administrators and school boards, in addition to teachers, are in a unique position to disseminate information about environmental hazards and to represent the interests and needs of children.[38] Schools should become community resource centers on environmental issues. Already there are many positive examples of this kind. For example, in 2005, California celebrated six years of "safe schools"[39]—a policy fought for by parents, children's activists, and enlightened educators. California's schools have

banned the use of toxic pesticides, and many other school boards in different parts of the country have followed their example.

If, in the same spirit, schools were to decide to purchase only organic foods for their cafeterias (further extending the protection from pesticides to their children) and to use only nontoxic cleaning and construction materials, they would create a huge market for these benign goods. Such a positive economic incentive would quickly provoke a production response, even from corporations that now make harmful products, as companies would seek to profit from this substantial "green" market.

*Health practitioners* also see children and parents routinely and have a vital role to play in protecting children from environmental pollutants. It is critical that training programs for health professionals begin to integrate information about environmental harms into their curricula and that continuing education programs be made available to professionals already in practice. Health professionals can and should play a much expanded role in helping to identify and treat environmental illnesses as well as to encourage the creation of policies aimed at prevention. It is essential that health professionals pool research and resources with epidemiologists, occupational health experts, and toxicologists.

*Public health officials* must be part of community efforts. By any other epidemiological standards, the health-related environmental problems of today's children, and the damage being done to their mental and emotional health, constitute a public health crisis in the present and developing into the future. Further, individual parents and teachers are not in a position to effectively advocate alone for environmental cleanups in the community, nor to support all the families and children who have been negatively

affected by environmental poisons. As a result we need to revive and expand our public health system as a matter of urgent public and economic policy. We need to do so for many health reasons, including the potential spread of infectious diseases, old (e.g., tuberculosis) and new (e.g., SARS). But environmental health—causes and solutions—must be included in the active mandates of these bodies, and public health bodies must be expanded to include experts in this field. For ultimately only these bodies can play the kind of leadership and coordinating roles we need as a society to practically identify and address the environmental assaults on children.

### *Government: Local, State, and National*

For all three community groups, as well as for parents, new roles, or even the adequate fulfillment of old ones, are not possible without awareness, education, and resources. Environmental problems were not created by individuals. Rather they were caused by a particular industrial mode of production that involved toxic products and technologies and placed profit over all other considerations. Logically, such problems cannot be solved by individual action. It takes the whole of society to protect the biosphere for future generations. To ask families, professionals, and individual communities to take responsibility for protecting children from pollutants, without giving them the resources and the power to do so, is like asking chickens to guard their henhouse against an army of foxes. It won't work. We must also accomplish a multitude of tasks on the big political board as well as at the family and community levels.

The American people need government to act as guardian of the environment and children's health. Given what appears to be a vacuum of environmental leadership in Washington, DC, at present, one call to action everyone could unite behind is for each

state government to create an official interdepartmental body with adequate funds, personnel, and power capable of animating citizens and community groups as well as its own departments and agencies into a system that makes the term *guardian* real in practice as well as in rhetoric. Such a system should be supported by municipal and county governments and, when the nation's capital regains its environmental senses, by generous federal support.

To address children's unique vulnerability to the adverse effects of environmental toxins, we must institute policies and initiatives based on the Precautionary Principle at all levels of government. This principle, which has already been adopted in many national and international forums dealing with health and the environment, amounts to a commonsense approach that uses a standard of reasonable doubt as the basis for policy, rather than waiting for irrefutable scientific proof (which can take years, even decades to achieve, long after irreparable damage has been done).

To effect the broad range of efforts and changes involved in societal environmental protection of children, we need the following:

- Public agencies with resources and clout, and free of personnel with conflicts of interest, to determine with more accuracy and honesty what harms are being done by what substances, processes, and technologies (for starters, bring back the Office of Technology Assessment and improve and expand it) and what alternative technologies exist or need to be devised to replace the harmful ones. This requires big budgets.
- Serious prioritizing inside the justice system. We need new norms that do not permit the endless postponement of trials in which toxic emissions are in question. Clearly,

sending CEOs of polluting companies to jail for a long time or setting fines that break the profitability of a company's business (instead of fines that are virtual licenses to pollute) are ways to make this strategy meaningful in the short term. These are the big sticks, and we'll need them for awhile.

- Economic carrots that are even bigger than sticks are, in the medium and long terms, the only really effective means of bringing about massive change. At the *economic* level, government's role should first and foremost be to devise a series of programs and incentives (rebates, tax reductions, subsidies, and more) to favor green technologies and disincentives (manufacturer-take-back laws, extra taxes, ending subsidies, and so forth) to discourage dirty ones. Using the purchasing power of all publicly funded institutions to create the basis for organic agriculture and nontoxic products can make an extraordinary difference. Either the existing corporate players will respond to these incentives or other organizations of people will—because given the right incentives, people interested in making green products will have the wherewithal to move ahead. Crucially, such public policies would provide a much-needed foundation for economic renewal on the basis of a living wage and productive work. Hence we should all support a national and worldwide campaign for a "Green Deal" to address the crisis, just as the New Deal addressed the crisis of the Great Depression. A campaign for a Green Deal can link efforts with campaigns for children's, family, and worker's rights, providing crucial economic support to employers and employees alike while shifting us to sustainable ways of living and production.

The good news—the great news—is that new clean technologies exist: from wind turbines and solar panels, to plant-based plastics, to nontoxic pesticides and scientifically enhanced methods of organic farming, to filtration systems that use plants to produce pure drinking water without depositing one ounce of sewage in our waterways, to methods of manufacturing that take no resources from the biosphere and even give some back; from government regulations that make manufacturers reduce packaging to a biodegradable fraction of what it was, to programs that conserve energy and reduce mercury emissions to zero, to programs that help us feed our kids healthy food at school. We *can* help our biosphere to survive and protect our children and their children after them—*if* we can prioritize health and control the deployment of technology and the major actors that drive it.

If we are to succeed in turning the tide, we must stop separating environmental issues from economic or health issues in the belief that somehow we'll be able to deal with those later. The costs of degrading human health and the environment must be borne by the industries that do the degrading and not treated as "externalities"—for it is citizens who end up paying for them. True "life-cycle costs"—from cradle to grave—must be integrated into all products. Not to do so is a form of subsidy to business, which cannot continue if we are to preserve our children's health. It is time to put environmental issues front and center in all fields and to start to live our lives, as communities and nations as well as individuals, with the knowledge that we are natural beings, dependent on a natural environment, and committed to becoming its guardians—and in the process we will become better guardians for our own children and all future generations.

## NOTES

1. Mittelstaedt, M. (2004, July 31). Where the boys aren't. *Globe and Mail*, A3.

2. See Olfman, S. (Ed.). (2005). *Childhood Lost: How American Culture Is Failing Our Kids.* Westport, CT: Praeger. The whole collection speaks to many of the dimensions of these problems. For broad summaries of these trends, see especially Olfman, introduction to *Childhood Lost*, xi–xiv; Healey, J., and C. West. (2005). The war against parents. In Olfman (Ed.), *Childhood Lost*, 57–88.

3. Landrigan, P. J., and J. E. Carlson. (1995). Environmental policy and children's health. *Future of Children*, Summer/Fall, 34–52.

4. National Research Council. (1992). *Environmental Neurotoxicology*. Washington, DC: National Academy of Sciences Press. See also: McElgunn, B. (1999). Protecting the brain: Neurotoxicants and child development. *Interaction* (Canadian Child Care Federation), *13* (1), 22–24.

5. For connections between persistent organic pollutants and precocious puberty in girls and problems of normal sexual development in boys there are many sources. See: Colborn, T., D. Dumanoski, and J. P. Myers. (1996). *Our Stolen Future: Are We Threatening Our Fertility, Intelligence and Survival? A Scientific Detective Story*. New York: Dutton; Swan, S. H., E. P. Elkin, and L. Fenster. (2000). The question of declining sperm density revisited: An analysis of 101 studies published, 1934–1996. *Environmental Health Perspectives, 108* (10), 1996; Solomon, G. M. (2001). Early puberty in girls linked to DDT metabolites: A review of Kristevska-Konstantinova M., Charlier C., Craen M., Du Caju M., Heinrichs C., de Beaufort C., et al. "Sexual precocity after immigration from developing countries to Belgium: Evidence of previous exposure to organochlorine

pesticides." *Human Reproduction,* 16 (5), 1020–1026. For emotional and psychological issues, see Levin, D. E. (2005). So sexy, so soon. In Olfman, S. (Ed.), *Childhood Lost*, 137–154.

6. In fact, the nutrient deficiencies in many diets, the pesticides and chemical food additives, and the chemical transformations in foods that result from forms of processing constitute serious mental health hazards for significant numbers of children. Because of the ubiquity of processed foods, even in the vast majority of U.S. schools these hazards can properly be called environmental dangers. It is very important that the now significant body of analysis that has been developed on these additives and processes, and the positive experiences with removing them, in schools as well as in homes, become part of what every educator, counselor, and therapist considers in assessing a given child or group of children. For brief introductions to and examples of the key issues in this field, see: Challem, J. (2003, January 18). Mean streets or mean minerals? *Nutrition Reporter*, www.thenutrionreporter.com. This article summarizes thirty years of research into the relationship among nutritional deficiencies, biochemical imbalances, brain function, and delinquent and criminal behavior. See also: Hersey, J. (2002). *Why Can't My Child Behave?* Alexandria, VA: Pear Tree Press; and Hersey, J. (2004, February 29). Hyperactivity, attention deficits, obesity and diabetes—On the menu in American schools? www.school-lunch.org/obesity.html#jane. These articles summarize efforts in North America and the United Kingdom to reform school cafeterias and improve the contents of vending machines, and gives the supporting research. Also see: Hersey, J. (2004, November 4). Montana school cleans up the playground, then the food, www.feingold.org/article-pg.html, reporting on dramatic improvement of student

behavior by dietary changes. And see: Hersey, J. (2003, April). At Wisconsin high school, students behave as they eat. *Education Reporter*, no. 207: "grades are up," "truancy is no longer a problem, arguments are rare, and teachers are able to spend their time teaching." And from the BBC: Junk food ban "calms pupils." (2002, November 5). *BBC News*; teachers at a London school reported that a ban on junk foods and fizzy drinks dramatically improved pupils' behavior. And from American television: Recipe for trouble: Food allergies. (2005, March 30). *Jane Pauley Show*, www.thejanepauleyshow.com/aboutshow/20050330.html, featuring Dr. Doris Rapp, whose books are also helpful on this issue, plus the stories of children and adults with serious food allergies.

7. Kohler, J. (2005, January 21). Colorado scientists find chemicals in waters. Associated Press. The USGS is in the process of conducting studies on water quality across the United States. For information on water quality in many jurisdictions, go to the USGS website, http://water.usgs.gov, and search accordingly.

8. Picard, A., and A. Favaro. (2005, February 14). Common foods laced with chemical: Levels of PBDEs rise, new research shows. *Globe and Mail*, A1; Picard, A. (2005, February 15). Flame retardants building up within us: Highest levels found in babies as PBDEs emanate from carpets, furniture to form dust balls. *Globe and Mail*, A19. Both articles were in response to a specially-commissioned study by the *Globe and Mail* and CTV, in response to new alarms about flame retardants; they reported the possible problems associated with PBDEs as memory problems, thyroid problems, learning disabilities, stunted growth, and "the stunning rise in attention-deficit-hyperactivity disorder."

9. WWF (formerly known as the World Wildlife Fund). (2003, November 24). Highly toxic chemicals contaminate the nation, http://www.wwf.org.uk/News/n_0000001055.asp; WWF press release. (2004, October 19). WWF publishes results of blood tests on environment and health ministers, http://www.env-health.org/a/1462; Watson, J. (2003, November 24). Toxic cocktail lurking in our veins. *Scotsman*.

10. Tests reveal chemical cocktail in EU ministers' blood: WWF. (2004, October 19). Agence France Presse. The tests, part of the WWF's ongoing Chemical Checkup program, analyzed the blood samples for 101 chemicals of five types: bromated flame retardants, phthalates, perfluorinated chemicals, PCBs, and organo-chlorine pesticides. See: WWF. (2004, July 12). EU ministers give blood for chemical check up, http://www.panda.org/news_facts/newsroom/news.cfm?uNewsId=14132&uLangId=1. The results of the previous tests, in December 2003, were similar to those announced for the July tests: WWF. (2004). Factsheet: Chemical contamination, http://www.panda.org/downloads/toxics/detoxfactsheetchemcheckup1.pdf.

11. "Home contaminants are important contributors to people's overall exposure and health effects because studies show that people in the United States spend 65% of their time in their residences," according to John Spengler of the Harvard School of Public Health. According to Spengler, this figure holds true for most other industrialized countries as well. For more information on John Spengler and the issue of body burden, and for information on toxic chemicals in everyday products, see: Betts, K. (2003, September 23). Cancer causing and hormone disrupting chemicals found in most U.S. homes. Organic Consumers' Association,

http://www.organicconsumers.org/foodsafety/endocrine100903.cfm. John Spengler's work is also described in a helpful summary of some of the work on body burden being done by leading U.S. researchers: Stevenson, M. (2005, March 5). I am polluted (Chemicals in our bodies). *Globe and Mail*.

12. Greater Boston Physicians for Social Responsibility. (2000). *In harm's way: Toxic threats to child development*. Cambridge, MA. Available at http://www.igc.org/psr.

13. Children's Environmental Health Network (CEHN). (1998). "Why children are not adults". Washington, D.C.: CEHN. See also http://www.cehn.org. CEHN is a national multidisciplinary organization whose mission is to protect the fetus and the child from environmental health hazards and promote a healthy environment.

14. Hill, B. L., and M. Keating. (2002). *Clean Air Task Force: Children at Risk*, 5–16, Boston, MA: Spectrum; Schmidt, C. W. (1999). Commentary: Poisoning young minds. *Environmental Health Perspectives, 109*, 187–192; Landrigan, P., et al. (1998). Children's health and the environment: A new agenda for prevention research. *Environmental Health Perspectives, 106*, 787–794; Bearer, C. F. (1995). Environmental health hazards: How children are different from adults. *Future of Children, 5* (2), 11–26.

15. The following references are excellent compendia, written in clear, everyday language, of children's special vulnerability to environmental dangers. They identify many of the key toxins on which research is substantial and the routes of exposure for children: Children's Environmental Health Network, Why children are not adults; Landrigan, P. J. (2004). Children as a vulnerable population. *International Journal of Occupational Medicine and Environmental Health, 17* (1): 175—177. For an older perspective, to view the evolution of research, see: Goldman, L. R. (1995).

Environmental health issues. *Environmental Health Perspectives Supplements, 103* (S6). See also Heilprin, J. (2005, March 30). The EPA says children may be more vulnerable than adults to carcinogens. Associated Press: "Under the previous EPA guidelines, last revised in 1986, cancer risks to children were assumed to be no greater than to similarly exposed adults. . . . In the first such update in nearly 20 years, the EPA said children 2 years old and younger might be 10 times more vulnerable than adults to certain chemicals. Children between the ages of 2 and 16 might be three times more vulnerable to certain chemicals."

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17. On the ubiquity of lead poisoning and failures to address it, see: Needleman, H. L. (1998). Childhood lead poisoning: The promise and abandonment of primary prevention. *American Journal of Public Health, 88*(12), 1871–1877. See also: New York State Department of Health. *Physician's Handbook on Lead Poisoning Prevention*, http://www.health.state.ny.us/nysdoh/lead/handbook/phc1.htm. On the connections between lead and crime, see: Needleman, H. L., C. McFarland, R. B. Ness, S. E. Fienberg, and M. J. Tobin. (2003). Bone lead levels in adjudicated delinquents: A case control study. *Neurotoxicology and Teratology, 24*, 711–717. On lead and violence, see summary of the evidence, including Needleman's work in: Organic Consumer's Association. (2004, August 5). Strong links between lead poisoning and violent behavior. *Rachel's Environment and Health News*, no. 797, http://www.organicconsumers.org/school/lead081004.cfm.

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21. Hu, Human health and heavy metals exposure, page 72.

22. Trasande, L., et al. (2005, May). Public health and economic consequences of methyl mercury toxicity to the developing brain. *Environmental Health Perspectives, 113* (5): 590-596. Mount Sinai pediatrician and lead researcher Leonardo Trasande estimated that between 316,588 and 637,233 children are born each year with umbilical cord blood mercury levels linked to IQ loss. The research found that the IQ losses linked to mercury range from one-fifth of an IQ point to as much as 24 points. As an example, Trasande said about 4 percent of babies, or about 180,000, are born each year with blood mercury levels between 7.13 and 15 micrograms per liter. That level of mercury, the group concluded, causes a loss of 1.6 IQ points. See also: Barrett, D. (2005, March 1). "Mercury damage to babies costs billions, study says." Environmental News Network, Associated Press.

23. Olmstead, D. (2005, March 15). The age of autism: Mercury in the air. UPI, http://www.upi.com/view.cfm?StoryID=20050314-052518-7615r. The Age of Autism is an ongoing UPI series tracking the roots and rise of autism. See also: Ackerman, T. (2005, March 18). Study links mercury from power plants to autism. *Houston Chronicle*, http://www.enn.com/today.html?id=7359. The study reported a strong correlation between higher mercury release levels and autism. The Olmstead article contains an interview with the lead author of the study, Raymond F. Palmer, an associate professor at the University of Texas Health Science Center in San Antonio. In answer to a question concerning data at the national level, Palmer said, "the data that I have at the states level, the 50 states, is consistent with the same idea. States that are reporting the highest levels of mercury emissions also have the highest rates of developmental disorders including autism."

24. Mercury study identifies problem spots. (2005, March 9). Environmental News Network, Associated Press. A four-year study in the northeastern United States and eastern Canada, funded by the U.S. Department of Agriculture's Northeastern States Research Cooperative, identified several mercury "hot spots" and suggests that contamination by the toxic metal is more pervasive than originally thought. The nine hot spots—four of them in Maine, one in New York, another in Massachusetts, and three in Canada—represent areas in which high mercury levels have been recorded in fish, loons, eagles, and other animals. The data caused researchers to question whether mercury from the sky is wreaking havoc on forest ecosystems as well.

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decision, Rep. Edward Markey (D-Mass.) said he was outraged that the EPA would suppress the Harvard study while claiming stricter controls would cost industry far more than the projected health benefits of its regulatory proposal, and Sen. John Kerry (D-Mass.) asked, "Why is the EPA suppressing the evidence that mercury pollution can be controlled better and faster?"

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28. Ontario College of Family Physicians (OCFP). (2004, April). *Pesticides Literature Review*. Toronto. The PDF is available at http://www.ocfp.on.ca/English/OCFP/Communications/CurrentIssues/Pesticides/default.asp?s=1. See in particular chapter 10, “Pesticide health effects and children.” For a summary of the report, see OCFP’s news release: OCFP. (2004, April 23). Comprehensive review of pesticide research confirms dangers. Toronto. The PDF is available at http://www.ocfp.on.ca/local/files/Communications/Current%20Issues/Pesticides/News%20Release.pdf. See also: Mitchell, A. (2004, April 24). Pesticides too harmful to use in any form, doctors warn. *Globe and Mail*. Some quotes: “children are far more vulnerable to the effects of pesticides than adults”; “no evidence that some pesticides are less

dangerous than others"; "the profoundly negative effects of some chemicals can be passed down through generations."

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30. Rapp, D. (1991). *Is This Your Child?* New York: William Morrow & Co. Research cited reported on pages 244-248.

31. Landrigan, P. J., and J. Slutsky. (1982). Are learning disabilities linked to environmental toxins? *Learning Disabilities Worldwide* (LDW), http://www.ldam.org/ldinformation/resources/O1-04_LDToxins.html. The article also cites the earlier work of Needleman, Leviton, and Bellinger: (1982). Lead-associated intellectual deficit. *New England Journal of Medicine, 306* (6), 367.

32. Pollution Watch [a collaboration of Environmental Defence and the Canadian Environmental Law Association] (2004, December). Shattering the myth of pollution progress in Canada: A national report; and Mitchell, A. (2004, December 8). Canada losing pollution fight, report shows: From 1995 to 2002, toxic emissions pumped into air, water and land rose by 50 per cent. *Globe and Mail*. Paul Muldoon, executive director of the Canadian Environmental Law Association, said: "There's this rhetoric that this problem has been resolved, but the data don't support that."

33. League of Conservation Voters (2003, January). *2003 Presidential Report Card*, page 3. Washington, D.C.: League of Conservation Voters.

34. As reported in the *New Scientist* of April 2–8, 2005, pp. 8–11 (and widely reported elsewhere). The *New Scientist* editorial "Save the Humans," in this same issue (p. 5), called the message of the Millennium Ecosystem Assessment (MA) "explosive" and concluded: "The most compelling reason for acting on the MA stems from one of its chief conclusions: there is a clear link between healthy ecosystems and healthy humans. Destroy those ecosystems and our economies—and our quality of life—will suffer."

35. In February, the EPA's own inspector general said that the Bush administration overlooked health effects and sided with the electric industry in developing rules for cutting toxic mercury pollution. See: Heilprin, J. (2005, February 4). EPA overlooked health impact. Environmental News Network, Associated Press. In May the attorneys general of thirteen states entered a joint lawsuit against the EPA, suing for more stringent rules and less reliance on "market forces" (i.e., the buying and selling of pollution units). At least three similar lawsuits were planned by coalitions of environmental groups. See: Groups seek tougher EPA rules on mercury from power plants. (2005, May 18). Environmental News Network, Associated Press.

36. Union of Concerned Scientists (UCS). (2004, March). Scientific integrity in policy making: investigation of the Bush Administration's abuse of science. *Report of the Union of Concerned Scientists* (P.2). Cambridge, MA: UCS. The UCS noted that these actions have consequences for human health, public safety, and community well-being. And they reported at length on specific incidents they were able to document that involved "air pollutants, heat-trapping emissions, reproductive health, drug resistant bacteria, endangered species, forest health, and military intelligence." The UCS also stated that "there is strong documentation of a wide-ranging effort to manipulate the government's

scientific advisory system to prevent the appearance of advice that might run counter to the administration's political agenda." This included "appointing underqualified individuals to important advisory roles including childhood lead poisoning prevention and reproductive health; applying political litmus tests that have no bearing on a nominee's expertise or advisory role; appointing a non-scientist to a senior position in the president's scientific advisory staff; and dismissing highly qualified scientific advisors." The UCS further adduced evidence that the administration "often imposes restrictions on what government scientists can say or write about 'sensitive' topics. In this context, "sensitive" applies to issues that might provoke opposition from the administration's political and ideological supporters.

37. Needleman, H. and P. Landrigan. (1995). *Raising Children Toxic Free: How to Keep Your Child Safe From Lead, Asbestos, Pesticides and Other Environmental Hazards.* New York: Farrar, Straus and Giroux. And Rapp, D., op cit.

38. See: Burstyn, V., and G. Sampson. (2005). Technoenvironmental assaults on childhood in America. In S. Olfman (Ed.), *Childhood Lost*.

39. California Safe Schools. (2005, April 12). Children's advocates celebrate six years of protecting student health: Reformed pesticide policy sets national model, http://www.calisafe.org.