Contaminated Without Consent

Why our exposure to chemicals in air, food and water violates human rights

By Sandra Steingraber, Ph.D.

Rachel Carson is the guiding light for all of us who care about the health of the planet and the people who live on it. With the publication of *Silent Spring*, Carson provided us four decades ago with a comprehensive exhaustively researched biological argument in simple lyrical language that anyone with or without training in the sciences could read and understand.

The book takes a four-part argument. First, Carson says we are all being contaminated without our consent to inherently toxic chemicals in the form of pesticides. Secondly, that the risks to our health and the health of other species are really needless because there are many non-toxic alternatives, if we only looked about us and sought them out. And then third, these alternatives are more effective than toxic chemicals because besides all of the unintended consequences of pesticides, the truth is that these chemical poisons don't really work very well in controlling pests. And finally - and this is the message I would like to elaborate because it is in the book and in her last speeches before Congress, but it is not the part that people really remember – she said we have the right to know about the risks that we are being compelled to endure, and once knowing we have the obligation to act.

Carson died eighteen months after *Silent Spring* was published. At the mid point between Carson's death in 1964 and today, 3 December 2003, came Bhopal. It was a wretched enactment of Carson's idea. The pesticide plant in Bhopal released the raw ingredient for a pesticide, methyl isocyanate, into the air. Eight thousand people immediately died. Another twelve thousand would die in the years to follow. No one knew what had happened to them, not even the doctors treating the patients knew what had happened because there was no right to know. The chemistry of what that pesticide plant was using was a trade secret. And so people died without knowing what kind of poison gas hit them. Their doctors struggled to treat them not knowing what antidotes might be possible. That so horrified the world that two years later in 1986 in the United States passed a comprehensive Right to Know Act on the basis that toxic chemicals used within factory walls or released into the environment that we all share – either by a terrible accident or through routine emissions into air, food, soil or water – form a public gesture and the public therefore has the right to know about them. That is now enshrined in the US legislation because anyone, including my students at the university, has the ability to dial up a website, type in their zip code and within thirty seconds have a read out of all the toxic releases in their home community, from what industry, in what amounts. You can click on the names of those chemicals and find out the health effects of being exposed. It's a very powerful tool for social activism and it was the dead of Bhopal who gave us that.

This article contains excerpts from the Rachel Carson Memorial Lecture held by Pesticide Action Network, UK on December 3, 2003 in London, England.

The young, teenagers and the elderly

Here is the idea: the old belief was called the 'dose makes the poison,' a phrase originally used by a mediaeval physician named Paracelsus who noticed when treating syphilis with mercury, the treatment of choice, that too much would kill the patient. 'The dose makes the poison' is still the principle upon which chemotherapy drugs are given to cancer patients. The hope is to give a dose the patient can tolerate, but large enough to poison the cancer cells. This is a very powerful notion in medicine and in toxicology. When a chemical is discovered to be inherently toxic – perhaps because it causes miscarriage or infertility, perhaps because it is a neurological poison that effects the brain, perhaps because it is related to cancer – instead of moving immediately to divorce our economy from depen-

dence on such a chemical the regulatory system requires instead laboratory studies (mostly on animals, but also on possible human exposure) to decide on the maximum dose allowable in the environment. Exposure routes could be as a residue in food if it is a pesticide, levels allowable in drinking water or ground water, or how much air pollution can we allow. Regulators set these so-called safe threshold levels. The idea is that above these levels there might be human harm, but below that the harm is mostly negligible.

The new science is showing that the timing of exposure makes the poison as much or more than the dose. This draws on the realization that we are not all middle-aged adults; we all begin our lives as embryos and go through a life span; and we are not the same individual biologically or physiologically during that entire life span. We go through important changes during our life and enter windows of vulnerability when we are exquisitely sensitive to the effects of toxic exposures – far out of the proportion that the dose might predict. Embryonic and fetal life is one of those times, and so is infancy.

For example, all of us have something called the 'blood brain barrier' that works pretty well to keep out any pesticide. Insecticides operate on the principal of chemical electrocution. They are all neurological poisons. The blood brain barrier will work pretty well to ensure that insecticide residues consumed with your dinner will not leave your blood stream and enter the brain matter where they can do some more damage. However we do not get a blood brain barrier until we are six months old. Anyone younger than six months is missing the suit of armor that surrounds the brain and offers pretty good protection against the neurological damage of insecticides. So tiny, vanishingly small exposures of insecticides to someone younger than six months can create disproportionate risks to the brain, and can be a terrible saboteur of that brain compared to similar or even much larger exposures for older humans.

The human rights implications of this new science need to be fleshed out, and let me offer an overarching observation. We are not providing under the law equal protection against toxic chemicals to all citizens. The new science shows that we are discriminating by age against particular groups of people, not only the very young but also I hope to demonstrate to you that adolescence, affected by the hormonal effects of puberty, represents another window when tiny exposures can create disproportionate risks to health. And old age represents another period when we are exquisitely sensitive to toxic chemicals because we start losing defense mechanisms. The blood brain barrier becomes permeable again. It starts to fall apart. Liver enzymes are no longer as efficient. The kidneys are not detoxifying as effectively. The immune system becomes compromised. So the very old and the very young physiologically resemble each other to a large degree and then in the middle you have the experience of puberty and adolescence which for very different reasons also represents a vulnerable window of time. I argue that our current model of regulation does not sufficiently protect these three groups: the very young, teenagers and the elderly.

Danger at beginnings of human life

Let us look at the threats to human life right at the very start: the stage of egg and the sperm. Women who smoke go into menopause on average two to three years earlier than women who do not. Something about smoking shortens the fertile life span of a woman: we now know the agent behind this is a chemical in tobacco smoke called benzoapyrene that cycles around the blood, gets into the chromosomes of the eggs, flips certain genetic switches, and programs cell death. So we know that cells can commit programmed suicide. The threat is called apoptosis. Benzoapyrene in cigarette smoke has this effect on human eggs in the ovary and shortens the fertile life span of women smokers. Laboratory rats exposed to benzoapyrene in the ambient air of their cages at levels in some of our larger industrial cities, experience a shortening of fertile life.

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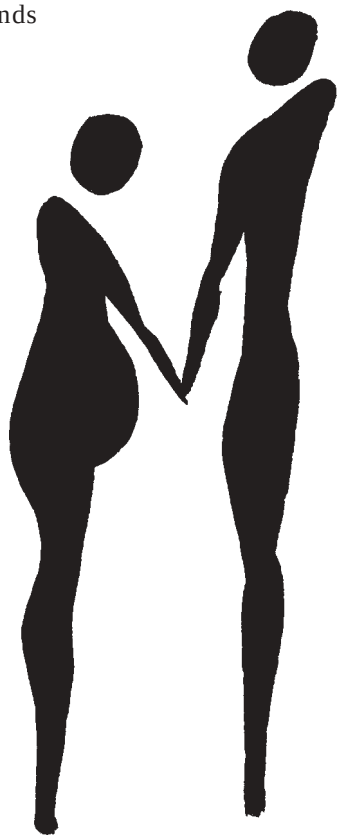
Sperm also are not immune to these effects. Studies of men exposed to pesticides through drinking water in some agricultural areas in the United States have lower sperm

quantity and lower sperm quality. These men are not farmers, but are simply living in farming areas and drinking the water in rural communities. We also know that males who have exposure to certain kinds of industrial chemicals, such as diesel and kerosene, father children who are at much higher risk for certain kind of pediatric cancers. In some cases, their children have ten-fold the risk, for example of neuroblastoma, a childhood cancer that tends to kill the very young. Children of men with these occupational exposures are ten times more likely to be diagnosed with neuroblastoma in the first two years of life than children of men of a similar socio-economic backgrounds and classes but who do not have such exposures.



Fertilization and Implantation. But let us continue our story. Let us assume that there is a viable egg and sperm. Fertilization occurs, grows into a morula and begins to implant itself in the lining of the uterus. The risk of exposure at this point in our story is not infertility but spontaneous abortion. Whatever your thoughts or opinions on abortion, we might agree that if you become pregnant willfully and with great joy, and then experience a spontaneous miscarriage because of a chemical that you were exposed to earlier on in your pregnancy, this is a violation of human rights, a violation of fetal protection and a violation of a woman's ability to choose to have a child. It is a form of chemical abortion. Evidence suggests that solvents and pesticides that enter into the story of pregnancy in the first few weeks raise the risk of interfering with the chemical cascade that has to occur: these are chemical messages that flow from one cell to another in the morula and as the morula turns into embryo with the extra embryonic membranes. All these require a choreography of messages being sent back and forth between the cells in the embryo and interference will cause this new life form to be flushed from the system because implantation does not take place properly.

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Week Five to Week Ten of Life. Let us go on with our story. Let us assume that a miscarriage does not occur, that implantation successfully happens. Now we are at about week five of a human pregnancy as midwives and obstetricians would date it. What happens next is a period called organogenesis. This takes place between weeks five and ten of a human pregnancy and during this time the entire human body is assembled, developing from the top down and from the center out. At the end of week ten of pregnancy you have a human being the size of a paper clip with all the body parts present. We have thirty more weeks to come. The danger at this point is a birth defect. Any toxic chemical that enters our story at this point and interferes with essentially the process of Japanese origami that causes these flat pieces of tissue to roll themselves up and fold themselves up into three dimensional human body structures will affect the human body form in some way.

We have pretty good evidence that exposure to pesticides during that week five to ten of a human pregnancy is linked to birth defects. Data [from birth registries] show that women exposed to pesticides, either because they work in farming, nurseries or greenhouses during the window of time in early pregnancy, have excess rates of particular kinds of birth defects. This is shown over again, no matter what the country: certain kinds of clefts, cardiac defects, limb reduction deficits, undescended testicles and hypospadias (when the opening of the penis does not happen at the tip but by the scrotum or under the shaft). Women who work in certain kinds of agricultural occupations have sons who are at higher risk for this kind of birth defect. The good registry data I could use in the U.S. (mostly from California and some from Texas and Minnesota) shows similar trends. In California, the closer a woman lives to an agricultural field where pesticides are sprayed, the higher her risk for stillbirth caused by birth defects. The highest risk of all is living within a mile of an agricultural field that is sprayed with pesticides. In Minnesota, interesting evidence shows that the further west you live in the State, the higher the risk of birth defects. The further west you go, the more intense the agriculture. Furthermore, there is an interesting seasonality to the data. Children born to farmers have high risks of birth defects, but even higher if their birthdays are in the winter: the period of organogenesis corresponds to the spring months of planting when pesticide use is the highest. So there is a spike of birth defects among babies born in the winter months of December and January. Now there is corroborating evidence from Iowa.

The Next Thirty Weeks of Life. So let us continue with our story. Let us presume the body develops in a perfectly

healthy way. There is no birth defect; the next thirty weeks of pregnancy are devoted to the growth and development of all those parts that were formed during organogenesis. One of the hallmarks of that development occurs in the fifth and sixth months of pregnancy when there is a huge spurt in brain growth development. During this month all those brain neurons that were formed during organogenesis start moving. They migrate. They spin out an axon and travel down it just like a spider that can propel down from a silken thread from the ceiling. And as these spider cells meet each other they spin the connections, which are a hallmark of being human. We do not have so many more brain cells than most other mammals but we have far more connections between those brain cells, and many of those are spun in the fifth and sixth months of pregnancy. The danger here is brain damage. So if pesticides, or a heavy metal like lead or mercury, enter our story at this point, those brain cells stop moving. They are paralyzed; they cannot find each other and the connections are not made. When the baby is born, its head looks perfectly normal. There is no malformation, there is no birth defect, but we cannot see the subtle change in the architecture in the brain underneath and we may not notice until maybe that child goes to school that there is a learning disability or behavioral problem like Attention Deficit Disorder or hyperactivity or autism. Now this is fascinating because it means we are changing the nature of the self through exposure to toxic chemicals. A child is born with a different mind than it otherwise would have.

Late Pregnancy. Let us go on. Let us go to the very end of pregnancy. We have emerging evidence to suggest that certain pesticides as well as certain industrial chemicals can alter the day of birth. We might think that our birthday has something to do with our astrological chart. I can tell you as a biologist, that the kind of chemicals that your mother was exposed to when she was pregnant, probably had as much to do with the day that you were born than the stars did. That is because certain chemicals such as PCBs and now we suspect DDT not only cross the placenta, but also can get into the fibers of the uterine muscle tissue itself and alter the way calcium flows through that muscle. The flow of calcium through any muscle determines whether it will contract or not. By opening the calcium channels of the muscle in late pregnancy, the uterine muscle will start contracting sooner than it otherwise would, and essentially shortens gestation. Babies are being born early. If this is more than three weeks before their due date they are officially classified as a preterm birth and we are beginning to realize that the stubbornly high incidence of pre-term birth in spite of good pre-natal care in the U.S. may be related to environmental exposures. Being born before you should is the leading cause of disability in the United States. It sometimes requires millions of health care dollars to save the lives of those babies and just bring them up to their birth dates. Very often, many of them require a lifetime of special medical needs and special educational needs.

The risks and benefits of breast milk

Let us talk about breastfeeding. There are two true things about breast milk, and they seem mutually contradictory, but they are not, and it is hard to hold two true things that seem like they contradict each other in your head at the same time. The first true thing about breast milk is that it is absolutely the best food for human infants. The data on the health benefits of breast milk are absolutely unanimous.

Here is the other true thing about breast milk. Breast milk, human milk, is the most chemically contaminated human food on the planet. Why is that? Well, you have to think like an ecologist. Breast milk occupies one rung higher on the human food chain, than the food that adults eat. What that means is that the milk making lobules in the back of a nursing mother's chest wall have one more chance to concentrate the poison found in things like toilet deodorizers, moth-proofing agents, flame retardants, pesticides, dioxins, PCBs. These are the most common contaminants of breast milk. They are commonly found in the food, but are ten to a hundred times higher in breast milk because they are persistent and concentrate as they move up the food chain. Nursing infants that feed on their mother's body eat one rung higher on the food chain than we who eat a combination of animal food and plant based food. For that reason, pound for pound, human infants are receiving many times more pesticide residues than we are. When safe levels are set for pesticide residues in food bought in the supermarket, no one thought "what are nursing in-

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fants going to receive if we allow this much pesticide residues in wheat, that much in sweet potatoes, this much in eggs, and this much in fish." No one thought that a nursing infant will get at least ten times that amount in breast milk. No one regulates breast milk, it is not transported across state boundaries and it is not sold in supermarket shelves. If it were, U.S. data indicates that many women's breast milk would not be available for sale because the amount of deleterious substances found exceed the accepted levels; the accepted maximum contaminant levels that allow you to sell something from the supermarket shelf.

So on the one hand, breastfed children are healthier, die less often, go on to be smarter, have better eye sight, have fewer immune problems, and do suffer less from allergies. On the other hand, measures of the blood of children in school, or who have been nursed, even for a period as short as six weeks, show four to five times more contaminants than their formula fed counterparts. So our breastfed children are paying a terrible price for their right as children to drink their mother's milk. And the right of the mother to feed the child milk from her own body is being compromised. The goodness of that milk is being compromised by the presence of contaminants. I want to be careful and say that we have not yet contaminated mother's milk to the point where it is a worse food for babies than formula but do we want to let it get to that point? The U.S. has terrible breastfeeding rates, we have the worst in the world, I think, of developed countries, because we fail to give women paid maternity leave. Formula feeding is thought to kill at least four thousand infants a year in the United States. In other words, if we enabled all women to breastfeed there would be four thousand less deaths of infants under the age of one every year in the U.S.

Contaminated breast milk is not killing four thousand infants a year. A risk benefit analysis would argue that as long as it is killing fewer than four thousand, then we should do nothing. But a human rights analysis should say, that no child should be harmed by contaminants in mother's milk. If we can raise the goodness of mother's milk, then we should do it and we should get chemicals out of milk. The answer is not to use formula milk, but to say that any chemical that is (a) known to be inherently toxic, and (b) known to accumulate in mother's milk, has no place in the twenty-first century economy and we need to immediately phase out any dependency that our economy has, whether industrial or agricultural on the use of this chemical.

Puberty: a window of vulnerability

Some words about puberty. This amazing rite of passage between childhood and adulthood is made possible by parts per billion concentration of steroidal hormones. You might remember the profound effects that puberty had on your psyche, your body, your thoughts, and your emotional life. Just parts per billion concentration of hormones elicited this huge change. We do not know a lot about the biology of puberty yet. But we do know that the body is growing rapidly, the skeleton is being mineralized and cells are dividing fast, so a lot of DNA is replicating. Whenever DNA replicates, it is more vulnerable to injury than when in its quiet state. All kinds of parts of the body develop hormone receptors so that they can become targets of hormones such as estrogen, testosterone or some of the hormones that your adrenal gland is producing, your pituitary gland, your thyroid gland. We in the biological community are worried about the effect that endocrine disrupting chemicals in the environment might be playing on this body that is primed to respond to hormones, because we know that there are chemicals out there that have the ability to mimic hormones inside the human body.

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Threats to the elderly

A word about old age. One of the things that interests me is dementia. My own dear adopted father was diagnosed quite a long time ago with Parkinson's disease. It developed, as in the case of 30 percent of Parkinson's patients, into full-blown dementia. Some preliminary evidence from laboratory animals shows that early life exposures to certain kinds of pesticides are associated with Parkinson's dementia. Laboratory animals exposed early in life, followed by an exposure in adult life, have two injuries to the brain, one very early and one later. The combination can elicit the cascade of neuro-degenerative changes leading to full blown Parkinson's. There is something about silent toxicities early in life, matched by exposures in adult life, which elicit changes and appear to be behind Parkinson's dementia.

All this, of course, is in controlled animal studies. However, we also know that certain kinds of farmers are more prone to dementia than other people and that certain kinds of veterans of wars where pesticides were used, such as the Vietnam War, are at higher risk for Parkinson's. Now we are looking closely at the Gulf War veterans. The first of the two military ventures in Iraq in 1991 has led to an entire generation of disabled veterans. Lou Gehrig's Disease, or what is called ALS, is one neuro-degenerative disease that these veterans appear to suffer from and perhaps Parkinson's is another one. So right now provocative evidence from both human and animal studies suggests environmental links to Parkinson's disease. I am now looking closely at the data, and I would like to expand that to include Alzheimer's disease. I have not yet cast my net there, but I would like to look at the entire human spectrum, the ways in which we enter and leave these vulnerable times, and the human rights problems connected to exposures during these periods of time.

Eliminating toxic chemicals

More importantly, I would like to look at ways in which we can re-cast our entire regulatory system, our entire way of delivering goods and services, and of growing foods so that we no longer need to use toxic chemicals. We can, as Rachel Carson encouraged, seek out alternatives and to stop taking counsel from those who tell us that the only way is to use poisons.

I always close my lectures with a short reading from one of the more lyrical and joyful passages of my books. I want to remind us that when all is said and done, this is really about human life and its joy. Behind every data point, is a human life and that is the reason for our interest. This is from chapter four of *Living Downstream*. This is the scene of my own amniocentesis with Faith. It is a procedure offered to what they call elderly prima gravida, meaning old mothers, like myself and in it about 30ccs or one short glassful of amniotic fluid is removed from the belly of a pregnant woman. In that fluid is contained the skin cells of the fetus, which can be cultured and grown to show the DNA, to see if there are any gross chromosomal abnormalities. The woman

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can make her decisions based on those results. So I underwent this procedure and here is what happened after that.

The needle is out. We're done. The mood is still upbeat. The obstetrician hands the pair of vials to the technician, who holds them up to the light like glasses of fine wine.

'Nice color,' she says. 'Do you want to hold them?' And she passes the vials, hot as blood, into my hands. The fluid inside is pale gold, it seems to glow. 'Well, it's like liquid amber!' I sputter, 'Like an amber jewel.' It occurs to me that amniotic fluid might be the loveliest substance I have ever seen.

The obstetrician touches my arm, 'That's baby pee,' she says, smiling. 'We like it yellow. It's a sign of good kidney functioning.' I look at the vials again, Oh right....

The obstetrician is finishing up, she reminds me to drink plenty of water today. Drink plenty of water. Before it is baby pee, amniotic fluid is water. I drink water and it becomes the blood plasma which suffuses through the amniotic sac and surrounds the baby – who also drinks it.

And what is it before that? Before it is drinking water, amniotic fluid is the creeks and rivers that fill reservoirs. It is the underground water that fills wells. And before it is creeks and rivers and ground water, amniotic fluid is rain. When I hold in my hands a tube of my own amniotic fluid, I am holding a tube full of rain drops. Amniotic fluid is also the juice of oranges that I had for breakfast, and the milk that I poured over my cereal, and the honey I stirred into my tea. It is inside the green cells of spinach leaves and the damp flesh of apples. It is in the yoke of an egg. When I look at amniotic fluid and I am looking at rain falling on orange groves, I am looking at melon fields, potatoes in wet earth, frost on pasture grasses. The blood of cows and chickens is in this tube. The nectar gathered by bees and humming birds is in this tube. Whatever is inside humming bird eggs is also inside my womb. Whatever is in the world's water is here in my hands.

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Ecologist, author, and cancer survivor, Dr. Steingraber. is an internationally recognized expert on the environmental links to cancer and reproductive health. Dr. Steingraber's highly acclaimed book, Living Downstream: An Ecologist Looks at Cancer and the Environment *presents cancer as a human rights issue. It was the first to bring together data on toxic releases with newly released data from U.S. cancer registries.* Living Downstream *won praise from international media, including* The Washington Post, *the* Nation, The Chicago Tribune, Kirkus Reviews, Publishers Weekly, The Lancet, *and* The London Times. *Continuing the investigation begun in* Living Downstream, *Dr. Steingraber's new work,* Having Faith: An Ecologist's Journey to Motherhood, *explores the intimate ecology of motherhood. The Library Journal selected* Having Faith *as one of its best books of 2001. In 2002, it was featured on "Kids and Chemicals," a PBS documentary by Bill Moyers. Dr. Steingraber received her doctorate in biology from the University of Michigan and master's degree in English from Illinois State University. She is the author of* Post-Diagnosis, *a volume of poetry, and coauthor of a book on ecology and human rights in Africa,* The Spoils of Famine. *She has taught biology at Columbia College, Chicago, held visiting fellowships at the University of Illinois, Radcliffe/Harvard, and Northeastern University, and served on President Clinton's National Action Plan on Breast Cancer. For more information on Dr. Steingraber's work, see www.steingraber.com.*