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with
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# Why Males Are Disappearing

And becoming more Feminized

A new report highlights the critical risks facing unborn males and male toddlers from gender bending chemicals found in everyday products. (the full report)

http://www.guardian.co.uk/society/2009/nov/06/health-eu

Boys born to women exposed to hormone disrupting chemicals have smaller penises, feminization of the genitals, are more likely to dress in girl's clothes and play with dolls.

Male infertility is rising dramatically. Young men today are half as fertile as their fathers.

Male births are declining compared to females at alarming rates.

Phthalates, one of the main chemicals used as softeners in thousands of items, soap, rubber shoes, bath mats and soft toys, have been blamed for blocking the action of testosterone in the womb and are alleged to cause low sperm counts, high rates of testicular cancer and malformations of the male sexual organs. Research suggest that male fetuses around 8-12 weeks after conception can be demasculinised by exposure to such chemicals.

Three quarters of all cosmetics, skin creams, PCV plastic and thousands other product contain Phthalates and DEHP known to cause reproductive abnormalities - especially in males. According to The Disappearing Male, a CBC documentary, 7 billion pounds of one of these, Bisphenol-A, is produced annually - used in the production of poly carbonate plastic, baby and water bottles, thousands household products including the epoxy liner in canned foods.

http://video.google.co.uk/videoplay?docid=7530701744597358451&ei=ndU-Sc-KFZ-QiQL369XeBQ&q=the+disappearing+male#

We are all exposed. The unborn male is the most venerable.

**Peat Myers, Chief Executive Officer of Environmental Health Science** has been involved with the science behind this issue since it began. He describes with profound clarity how hormones bind with DNA which trigger protein expression - and how chemicals that mimic hormones, in this case estrogen, are altering human development around the world.

## A New Picture of the Relationship Between the Environment and Health

M: *You seem to be on the cusp of a revolutionary field examining how chemicals are obstructing human development. How did you begin?*

John Peterson Myers, Ph.D.
Chief Executive Officer
Environmental Health Sciences

P: I'm a Biologist by training. I've actually trained in the ecological sciences and have been studying migratory birds for 15 years. Part of those studies forced me to ask why are these populations declining?

I was working with a species that had undergone a 90% decline and had done a lot of reading on a range of issues, including in the possible contribution of pesticides to those declines.

I hooked into the field by meeting some extraordinary people, including a woman named Theo Colborn in the late eighties, almost twenty years ago now, who came up to me one day after a lecture. She said, “Pete, I’m so glad to meet you. I’ve got to tell you about my work”.

Here’s this amazingly energetic woman who had just gotten a Ph.D. in her sixties. Amazingly energetic, she stumbling into an astounding new way to look at how the environment and health interact. Theo and I spent the next five years or more teasing things out. I met through her a remarkable array of basic scientists and scientists who are experts in reproductive and developmental biology, who frankly, hadn’t spent a lot of time thinking about human health issues. They were focusing on biological processes.

Theo had this amazing ability to connect a series of dots, and to extract out of this chaotic background a pattern that told a whole new story. The new story that emerged was that we’ve made some pretty stupid design decisions over the last 80 or so years in the types of materials that we put into products and some of the chemical processes that we used to produce those material.

Without realizing it we were selecting chemicals that had the capacity to interfere with our hormones at amazingly low levels that toxicologists just hadn’t thought were relevant. As this picture emerged the network of scientists grew. It’s actually a worldwide now, thousands of scientists are working on these issues. As a result of building upon new studies, we have a completely transformed picture of the relationship between environment and health.

M: *What were the dots that she connected?*

P: The initial dot was her realization that she was asking the wrong question. She had an assignment looking at the health of wild life in the Great Lakes asking questions about whether the contamination that was so obvious in the 60's and 70‘s and 80's was causing cancer. She went through hundreds if not thousands of papers that were looking at fish, at birds and mammals in this region.

She realized it wasn’t cancer that was being caused. There were some cases of cancer but the over-riding picture was that these animals had an array of diseases, deformations and disabilities that were symptoms of having had developmental problems caused by hormone imbalances. She began to ask how could hormone imbalances be the result of this type of exposure? That led her to a growing body of literature on the ability of certain contaminants to alter hormone balance.

M: *I remember reading some little blurb about bleach bottles and mice. That was a big deal. Tell me about that.*

P: A lot of science happens, the initial discovery, by accident. In this case there was a scientist named Patricia Hunt at Case Western Reserve University, a world leader, along with her husband, looking at what causes cell division to lead to Down Syndrome in babies.

The basic cause of Down Syndrome was well understood. It's an error in cell division called an 'uploading' that winds up with an extra copy of chromosome 21. Babies that have that extra copy have Down Syndrome. Dr. Hunt was studying 'uploading' using mice in an experimental model she had developed with her husband over a number of years.

She was running her experiments when one day, literally overnight, the rate of this cell error in her mice increased by twenty fold. Not just twenty percent, but twenty fold. A huge signal. She was totally surprised by what happened and it took about six months to figure out that a lab tech had inadvertently washed out the plastic polycarbonate bottles that she was using to give the mice water. They washed the plastic bottles with bleach.

That bleach had broken some chemical bonds in the polycarbonate and let loose a flow of plastic material called - Bisphenol-A - into the drinking water of the mice. Dr. Hunt then used a series of very elegant studies to show definitively that this compound at extremely low levels was capable of causing an error in cell division.

M: *Back in the 70's I was a scuba instructor. There was Ocean's magazine. One of the lead stories had to do with pelicans and the impact of DDT. Shells were just breaking. Is this related?*

P: DDT was actually my first exposure to this issue. Not when I met Theo, but almost 20 years before. There was a famous study done on the Channel Islands in Santa Barbara by people involved with pelicans. They discovered that Western Gulls, a species of sea gull that live on the Channel Islands had female-female mating pairs of which was quite unusual in wild bird populations. This provoked a series of questions, what could be causing it?

A scientist at University of California Davis did some experiments where he took gull eggs and injected DDE in those eggs. DDE is the metabaloid of DDT. *He was able to partially feminize* the offspring that hatched once they had been exposed to DDE.

M: In your presentation yesterday you described how hormones, in this case Estrogens in the environment serve as genetic triggers and that these triggers control the full spectrum of development in animals and humans.

P: This is a very important observation. Most people don't have much knowledge about how hormones work, what they do, how they interact with genes. It turns out that hormones basic function is to control the turning on and turning off of genes. Genes are active throughout our lives. They're crucial in guiding development. They have to be turned on or turned off at the right time so the right protein is present. If this trigger is not there or another is at the wrong time, you may not have the right number of fingers. Your brain may wind up being wired inappropriately.

Genes are not these passive little things that we just inherit from our parents. They're active.

They're a symphony throughout our lives. A symphony needs a conductor and hormones are the conductors. Hormones signals are generated by a wide array of factors. Hormone signals guide the turning on and turning off of genes. It's called gene expression. That's central to life.

We've discovered that some contaminants, at extremely low levels are capable of interfering with the signals that are turning genes on and off. They do that by mimicking hormones or by blocking hormones. In one way or another some contaminants amplify or diminish the signals specific hormones should be sending. They interfere with the degree and timing of gene expression. Some aren't being turned on or the trigger is happening at the wrong time. Some may be silenced permanently.

M: *What happens then?*

P: There are problems.

M: *You use the analogy of the symphony to describe how this constant array of triggering takes place.*

P: It's so exciting, so beautiful to see what nature has created. But it has to work in the right way. Imagine Beethoven's Fifth. Imagine it's going along, dunt-dunt-dunt, and then the note doesn't hit. That's jarring to those of us know how is should sound. It's devastating if the gene that's needed at that precise moment doesn't fire in the development of an organism. It's devastating.

M: *I remember, perhaps ten years ago, seeing images of frogs with five legs. These frogs and amphibians were canaries in the coal mine because they were so sensitive to environmental contamination.*

P: There are several different frog stories that are very fascinating. One frog story is about what scientists call "intersex" or "hermaphrodisme" where you have frogs that have mixed gonads, both testes and ovaries. It's not normal in people, it's not normal in frogs. That is clearly due to, at least in the cases that have been well studied, exposure to pesticides that are turning on a gene that speeds the conversion of testosterone to estrogen.

Gene products often capitalize other chemical reactions in the body. In this case you've got a gene that's turned on and produces an enzyme called Aromatase. Aromatase's job in the body, at least one of the jobs, is to take testosterone and make it into estrogen. When that happens too rapidly in development in these frogs are de-masculinized and this intersex condition is created. That's one very well studied phenomena.

In the late 90's there was another frog issue that burst upon the public scene when a group of school kids in Minnesota were on a field trip and discovered a pond full of deformed frogs with multiple legs and eyes in the wrong places. A scientific debate erupted over that issue and it took almost a decade to finally reach some closure. Not surprisingly. It's complicated.

It's not just chemicals. It's a combination of processes. The picture right now is that several things have taken place as a result of human changes, impacts on the environment that lead to these local eruptions of frog deformities. The current view is that the actual deformity in those frogs is being caused when a natural parasite of the frog creates a cyst in the tadpole, near the developing leg of the frog. When the frog changes into an adult that cyst causes the bizarre deformities.

M: *Tell me about Theo.*

P: Theo began her professional life as a Pharmacist in New Jersey. Her brain during those years was trained to remember pharmaceutical names of chemicals. She also learned an immense amount about pharmacology during those years. She moved to Colorado and became a sheep farmer for a decade or so. While she was there she began to get involved in some of the pollution issues that were affecting the streams that were affecting her sheep and her sheep farm. She decided that to be an effective spokesperson, defending the water quality and her farm, she had to have some letters after her name. So she went back to graduate school, ultimately earning a Ph.D. She left the sheep farm and worked in Washington for over a decade. It's an amazing story. She got her Ph.D. at the age of 59 and changed the world after that.

M: *There's two things that I think are fundamental. One is small amounts of contaminants needed to cause profound changes, and two is the sensitivity of the prenatal period.*

P: One of the key pieces of science that's emerged is the fact that some contaminants are amazingly capable to alter gene expression at extremely low levels, levels that Toxicologists couldn't even measure 15 years ago.

There's a plastic material called Bisphenol-A invented in 1938, during a period of chemical creativity when people were synthesizing all sorts of things. In this case they were looking for synthetic materials that could be a substitute for estrogen. They found Bisphenol-A was capable of provoking an estrogenic responses in animals. They discovered Bisphenol-A at the same time, the same period in which people discovered first synthesized Diethylstilbestrol, which is an infamous medical drug used as an estrogen to manage difficult pregnancies that has a very, very sorted history.

Diethylstilbestrol or DES was much more powerful at first glance then Bisphenol-A. They focused on DES and basically put Bisphenol-A on the shelf. It stayed there for about ten years until a polymer chemist discovered that you could take the individual molecules of Bisphenol-A and combine them in a chain and make polycarbonate plastic. That's what plastics are, chains of molecules. Polycarbonate is ubiquitous. It's used to make all sorts of water bottles, to make the lining of food cans and many other things.

The problem is that the chemical bond that combines the molecules of Bisphenol-A in to that polycarbonate are not non-stable. They degrade with time. So the compound leeches into the food or the water.

The leeching rate is parts per billion. 15 years ago people would have thought well so what. That's irrelevant to health. We need big amounts to cause affects. Little amounts aren't a problem. Scientists at EPA had done an assessment. They looked at studies of high levels of Bisphenol-A and discovered that the lowest affect level they could find was on the order of fifty parts per million. Much, much higher than what was leeching into the food and water as the polycarbonate degrades. So it looked fine.

But then some scientists began to ask questions from a somewhat different perspective and they weren't Toxicologists. They were reproductive biologists who had realized that the amount of hormones in the blood stream that's free was much lower than people had originally thought. In fact most estrogen that's in our blood is tied up with other molecules and is bound. It's not biologically available to send signals.

What these scientists realized was that the proteins that are binding estrogen don't bind Bisphenol-A, which means that Bisphenol-A may be relatively weak compared to estrogen, but there's functionally more of it. They did some calculations and realized Bisphenol-A can cause affects in the part per billion range which was a totally unexpected prediction. They tested that and they confirmed their predictions.

If you take a little bit of Bisphenol-A and put it in corn oil and feed it to a mouse while she's pregnant, and the amount is equivalent to two parts per billion of her body weight, a male mouse in her womb at the time will grow up with a prostate that's much bigger than it should be. Also its structure will be been changed so it's hypersensitive to hormone stimulation. It's got a different prostate, one that's predisposed to prostate problems. It was a very controversial result, but this has been confirmed by independent scientists.

This work done in the late nineties was immediately criticized by industries. An important result like that needs to be confirmed by independent people to make sure it is right. To date, by December of 2004 there have been eleven industry efforts to replicate the low level affects of Bisphenol-A, not just the prostate affect but in general the low level affects beneath the level the EPA tells us is safe. Eleven efforts by industry to do it, every one of them didn't show an affect.

There were 105 academic studies funded by the government. Of those 105, 94 showed positive affects. You've got industry funding 0 out of 11. Government funding 94 out of 105 showing positive affects. Something is wrong here. In the public debate industry points to those 11 and say this isn't a problem. There's a drum beat coming out of some trade associations that basically say the only relevant research has been their initial study and maybe one or two others, ignoring the 105 government studies.

And frankly indulging in the worst of tobacco science to try and protect their product.

M: *What do you mean tobacco science?*

P: There are very good industry scientists, very honest people. But in this instance of Bisphenol-A also with Aromatase the herbicide, we see grotesque distortions of science that compete with the best examples of industry's defending tobacco. It's straight out of the tobacco play book. About two weeks ago in a public health journal there was an analysis of tobacco science. Public health scientists had gained access to a large repository of documents from the Phillip Morris Company, documents that were made public as a result of tobacco suit settlements and were not designed to be read by outsiders that shed light on the practices that they were using to, in this case, obscure the links between second hand smoke and sudden infant death syndrome.

This was a very concerted effort that involved paying scientists to write distorted papers that didn't reflect what the real science was saying. This came out in January or February of 2005. It was about events taking place in 2001/2002, at a time when the tobacco industry was saying oh, we've been bad guys, we've changed, we're responsible citizens now. At the same time, right now they're pursuing a pair of scientific historians at Columbia University, aggressively going after them because they've written an amazing book called "*Deceit and Denial*" which is an eighty year history of distortive practices in science on key chemical issues. I know that there are very responsible people in those industries, but at the same time there's a process that's going on that's not letting them make all the decisions. It is an old story still being played out and one that we should be more aware of.

M: *Let's deal with this ethical issue and the roll public media plays. You're in the business of trying to influence and educate.*

P: We're in the business of helping journalists understand what this science means. You look at the dynamic of media today and it's a very challenging business. The economics have changed dramatically over the last 20 years. Hard working, day-to-day journalists are on a deadline and have a real problem dealing with complex issues. They don't have the resources to do it.

M: *There's a sense, this is again is my personal bias, that we don't have much real journalism anymore. It's all scripted.*

P: I disagree with that. I run an organization that is constantly scanning mainstream media for stories about environment and health and it's been quite a revelation to me. If all you do is look at one or two or three newspapers, say your local paper and the regional paper, and then one or two national papers, on any given day you might see three stories, max. Some days you won't see any. But my team and I look at hundreds of newspapers from around the world every day.

In fact we have web tools that allow us to monitor thousands of newspapers every day. As a result we're seeing somewhere every day, somewhere in the world press, there are a total of usually 70 to 120 stories that are relevant to the environment and health. Now, not all of them are about contamination in the chemical sense in health. Some of them are about sewage. Some of them are about failures in the public health system and ... Avian flu which is a huge problem. Some of them are about the long term consequences of global warming. But you add them all up and there's an amazing rich diversity of press coverage of these issues and a lot of it is really good writing, really good writing.

One of our jobs at Environmental Health Sciences is to rake that stuff in, put it in one place, chew it up with some software, spit it back out and make it easier for people to find, people to read, people to keep track of how these events are unfolding. It's absolutely fascinating to watch this unfold. It's left me develop an immense respect for the journalist who despite the changes in the economics of their profession, despite the incessant hard deadlines of daily reporting, they do good work. The problem is the science isn't getting any simpler. It's getting more complicated. The challenge is how do the working journalist, who's facing a daily deadline, doesn't have the resources to relax, sit back, think big thoughts about how this fits in a broader context, how do they keep track of this stuff? It's a challenge and my hats off to them for the job that they've accomplished.

M; *We've done a good job of talking about the small doses introduced at a strategic moment screwed the whole thing up. Now let's talk about the stages.*

P: One of the great mysteries of public health today is asthma. Why? Asthma is now, in the United States, is the single biggest cause of kids going into hospitals today. It's one of the leading causes of childhood death today. Asthma is a major problem and it's come upon us suddenly over the last two decades.

Think back 20 years ago and look at the data. Asthma was no where near as prevalent then as it is today. The question is why? What's going on? The people who study asthma have some good ideas about asthma triggers. Is it the environment that provokes an asthma attack? That's a different question from why is the immune system of that kid hypersensitive to the triggers? The triggers have been around forever. In fact, in a lot of places the air itself is cleaner than it was 20 years ago. Yet this respiratory problem is dramatically worse.

Scientists have separated the study of asthma into two different issues. How the triggers work and how do we help kids avoid the triggers and manage the disease? And the other area is why is that immune system so reactive now when it didn't use to be? We don't have the answers. We do have some clues.

There's some fascinating work been done looking at how kids growing up in areas where there's a lot of diesel appear to be at more risk of developing asthma over time, particularly if they spend a lot of times outdoors.

But for me one of the most intriguing studies that's come out, a piece that was published last summer, in the summer of 2004, where a group of Swedish epidemiologists studied kids in Sweden and looked at risk factors for asthma, not the triggers but asthma itself and discovered that kids that had relatively high levels of a plastic compound called Phthalates, were at much greater risk developing asthma than the kids who didn't. Now this material, Phthalates, are big group of chemicals. This was one type of Phthalate called Diethylhexyl Phthalate, DEHP, used in vinyl tiles and other things like that to alter the characteristics of vinyl, Polyvinyl Chloride (PVC). As people walk across it over years it creates dust. So the dust in rooms that have vinyl tiles have Phthalates in the dust. And kids who grow up with Phthalate dust in their bedrooms are predisposes to asthma.

I was fascinated by that result because it turns out there'd been some speculation previously that if you look at the molecular structure of this particular Phthalate, and especially what it becomes when it gets inside your body and enzymes chew it up and change it chemically into what it's called a metabolite. That metabolite is very similar in structure to a key signaling system in that controls the sensitivity of the immune system.

What that metabolite looks like is very similar to a natural signal that our body uses to adjust the sensitivity of the respiratory tract immune system. What this suggests, it's clearly not certain yet, but it's a huge signal saying we should be looking at the possibility that these Phthalates are ratcheting up the sensitivity of the immune system, which then creates this hyper reactivity to triggers for asthma. This may be a very significant factor contributing to the asthma epidemic.

There's now Epidemiological data that are consistent with that and I think it's a huge signal that scientists working in this field should be paying attention to. At the same time I think it's a signal that tells me people should be cautious about their use of materials that contain Phthalates.

M: *The immune system is set like a thermostat and these chemicals are interfering with the setting.*

P: Precisely. One of the interesting aspects of this science that's come out over the last 20 years is you have both immediate affects and you have long term affects. Take the affect of Bisphenol-A on prostate development. It not only changes the size of the prostate, but it increases the numbers of what are called Androgyne receptors in the prostate.

The classic way for a hormone to work is that you have a hormone going through the blood, getting into the cell, and then the cell it enters into the nucleus. And in the nucleus it combines with what's called a receptor. So you get the hormone and its receptor and together those two bind to and stimulate the DNA to produce something. You can alter how the system's responding by putting more hormone in. You can also alter it by having more receptors to receive the hormone.

This prostate study shows is that early exposures to very low levels can alter the sensitivity of the system throughout life by changing the receptor density, the number of receptors that are there to receive that signal and then cause the change in DNA expression. So we're seeing a potential for immediate affects by changing genes - now - and also we're seeing lifelong patterns of altered sensitivity being set in place by very early exposure.

M: *I'm assuming that early exposure means prenatal?*

P: It can be prenatal. Another one of the messages out of this revolution in science is that early exposures can affect events later in life. Early exposures can take place at multiple places along the developmental pathway. A lot of it happens in the womb, some can happen around birth. There are other things that happen around puberty. There are key transitional stages in life where sensitivity appears to be enhanced. They're not exclusively those times, but those are the times when we worry most about the interference of these signaling disruptors with biological processes.

M: *Basic structures are being built in the womb. The transition out of the womb is a huge transition, where whole new systems are being activated and others shut down. Then puberty comes along and you're born again.*

P: The physiologists and developmental biologists who work on these issues talk about organizational changes when people or animals go through those stages of life where there are big changes. Metamorphosis in frogs. Puberty in people. There's massive restructuring going on that all involve gene expression, involve responses to signals, natural signals, and those are times when an unnatural signal is likely to cause a profound effect.

M: *Let's go through those developmental categories and give some examples of what you're seeing.*

P: I'm most familiar with the prenatal period. One of the things that's been worked out with animal experiments is that stresses in the womb can cause behavioral effects much later in life. Various compounds can alter sexual behavior. They can alter maternal behavior. Exposure in the womb decreases the mother mouse's investment in her babies. She doesn't nurse them as much. She spends more time away from them. These are not large exposures. They're very small exposures that she experiences when she is in the womb, but then alter how she behaves as a mom much later in life. It's very well worked out in animals. It's very difficult to do in people.

M: *What can we learn from animal experiments about people?*

P: I look at what's happening in the world today and I'm worried about the condition of families. I'm worried about suicide rates, about dysfunctional kids, and I speculate in my mind about what's causing it. I run into a problem as a scientist because I know that all sorts of things are at play. It's very difficult to isolate individual causes.

It's also difficult to establish with certainty that change has taken place because our data tracking long term things changes. We don't have good records.

One of the area where it's clear things are going on is in terms of things like attention hyperactivity disorder, learning disabilities. There the animal literature is very clear. We can cause, in animals, behavioral changes that mimic as close as you come to ADHD and we can do it with low level exposures to arrange a different contaminates, all of which share the ability of altering the way the brain develops.

Brains develop through genetic signaling and when you interfere with those signals you wind up with a brain that's mis-wired. We know we can do it in animals. We know that people are exposed to the compounds that are causing the things in animals. We know they're exposed at levels that are relevant. They're within a range where we're worried about there having affects. And we know in some cases there is some pretty strong epidemiological data linking altered cognitive function in children and exposure in the womb to these chemicals. To PCB's. The strongest case is Lead. Lead clearly impairs intelligence at very low levels of exposure. We know enough now to be confident in the conclusion that certain types of contaminants are interfering with kids cognitive abilities as they grow up. That's one aspect of behavior. It's highly likely that they're contributing to things like ADHD.

Exactly what range of the behavioral dysfunctions that we see in the world that I as a person, not as a scientist, sense is increased? What fraction of them might be associated? We don't know. It's now become a serious plausible scientific hypothesis that this sort of exposure could be involved. I, as a parent, have made investments on a precautionary basis to reduce the exposure of my kids to some of these things. I just don't want to take the chance. The science isn't certain.

M: *Estrogen and testosterone, these have a lot to do with sexuality and reproduction. Those seem to be pretty sensitive systems. What are some of the indicators that you've seen about these chemicals affecting human sexuality and also behavior?*

P: The most pertinent involves some new results that look at exposure in the womb to a sweet of chemicals called Phthalates that, from animal experiments, we know definitively act to de-masculinize and feminize males exposed in the womb. There's no questions about that. We've got multiple cases documenting affects on behavior. We know some of the genetic signaling mechanisms that have been altered by exposure to these compounds. The animal literature is really clear.

M: *What can we say about people?*

P: We know people are exposed widely to Phthalates. The Center for Disease Control has issued a series of studies over the last five years that makes it clear that many people are exposed to levels of Phthalates that are high enough to be at a level of concern.

We are exposed. We know what they cause in animals. What can we conclude about people? Unfortunately it takes a long time for Epidemiologists to answer these questions. The truth is they just started to ask them.

M: *What do we mean by the feminization?*

P: Boys born to moms who in their blood and urine have high levels of Phthalates, indicating that the babies were exposed to high levels in the womb, these boys are much more likely to have a feminized reproductive tract.

When I talk to the public, talk with my family about these things, often the reaction is gee, thanks Dr. Doom! We really needed to hear that! It's terribly depressing. You're telling us that there's wide spread exposure to mixtures of chemicals which at low levels cause changes in gene expression that are likely driving a range of different diseases. Thanks. What do we do? There's an element of despair there. That's not how I react to it. I get really excited because what we're learning with this science is the diseases we had no idea were preventable, we're learning a range of these diseases are preventable. That's the point I want to make.

M: *Let's go there.*

P: If you step back and look at the overall picture, what it looks like is this.

We've synthesized some chemicals and put them into products and processes that have led to wide spread exposure. And some of these chemicals are capable of changing gene expression, capable of altering development, capable of interfering with behavior with immune function, with fertility, capable of causing a range of diseases.

We've done that for the last 50 years without being aware of what we were doing. Now we're learning. We're learning that a range of today's epidemics have varying degrees of to exposures. Exposures during development especially in the womb. That's unsettling news. We've come to love some of the products that now are biting us unexpectedly. That's unsettling. It's, to some degree, disabling. It's a message, at least of first bush of despair. What do we do?

This science is telling us that we can prevent diseases today that we had no idea ten years ago were preventable. That's really exciting. This new science is turning on its head the old separation between genes versus environment. It's not genes versus environment, it's genes are environment. Yes we get genes from our parents. That's heredity. But how those genes are turned on and off, that's the environment. They're turned on and off by what we eat, by stress, by maternal love, and I mean that quite literally.

We have lots of experiments now with animals showing that maternal behavior alters gene expression. It affects how we behave. What our health is as adults. Environmental contaminants are part of that picture altering gene expression.

Most people read that story and say oh my God, there's another heredity disease. What can I do about it? It's a fatalistic interpretation and it's a wrong interpretation.

When I read this disease is linked to that gene the first thing I start to ask is anyone looking at the environmental factors that altering that gene's expression? If we can identify that, then we can prevent that disease. When you start to look at the array of human health conditions today, behavioral dysfunctions like ADHD, like Parkinson's, like Alzheimer's, you look at the range of hormonally related cancers like breast cancer. You look at Lymphoma and a wide array of today's diseases of modern society. There are links to changes in gene expression, strong links, for many of them. That tells me they are candidates to being prevented. Let's go there. Let's flip this whole thing on its head and say wait a second. It's not a source of despair, of fatalism. This new science is telling us how we can solve health problems that are plaguing society today.

M: *You mentioned the green chemistry. You talked about new work being done in this field, William McDonough 's work for example. We're at the threshold, and again to use his words, of a new industrial revolution that basically has this science as its foundation.*

P: This new science is giving us design signals. It's telling us we've selected molecules that cause things we don't want. Our challenge today is figuring out what we want and designing materials and products to give us the services we need without the unintended consequences. That's the challenge and we're moving there.

There's a remarkable field developing. It doesn't have all the answers called Green Chemistry. It looks at the problems caused by Bisphenol-A and polycarbonate. It's has got two problems. One is that the Bisphenol-A molecule interacts with the estrogen receptor and causes changes in gene expression we don't want. The other is that polycarbonate itself, which is made of weak molecule bonds so it degrades. Green Chemistry looks at this problem and says let's have a different molecule that doesn't interact with the estrogen receptor. Let's develop a polymer that uses stronger bonds so that they don't degrade.

Those materials are there, they're going to be synthesized and created, and entrepreneurs are going to realize they can make money by producing a bottle that holds water that does the same thing that Bisphenol-A but doesn't cause the health problems that are associated with Bisphenol-A. And they're going to make a lot of money. They're going to put the people who insist on producing Bisphenol-A out of business. That's a dynamic in our economy that we can make work to our advantage, to peoples advantage, to our health's advantage. And it's going to happen as Green Chemists make these advances and entrepreneurs respond to the opportunities that those advances create.

http://www.guardian.co.uk/society/2009/nov/06/health-eu

http://video.google.co.uk/videoplay?docid=7530701744597358451&ei=ndU-Sc-KFZ-QiQL369XeBQ&q=the+disappearing+male#