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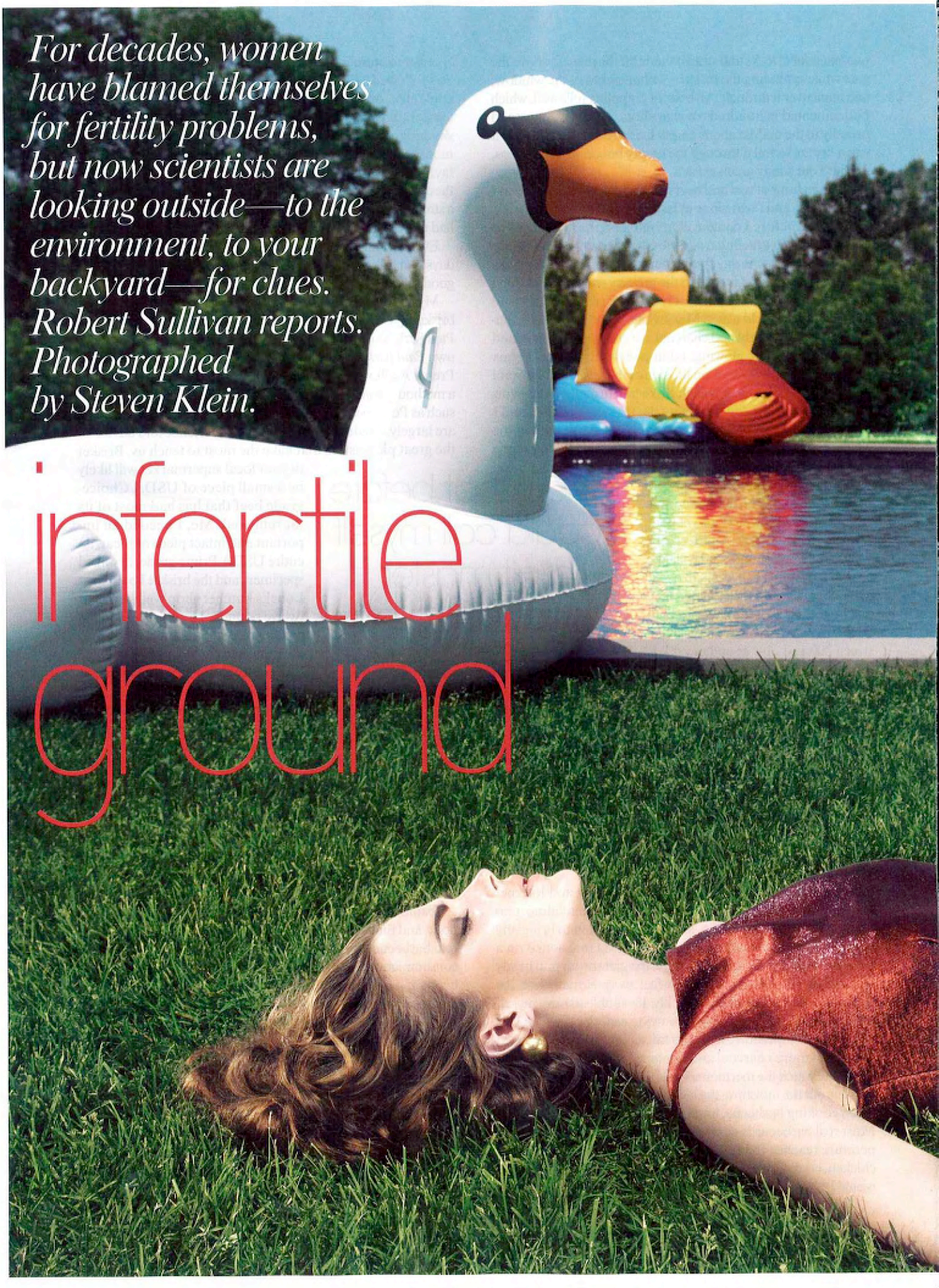
For decades, women have blamed themselves for fertility problems, but now scientists are looking outside—to the environment, to your backyard—for clues. Robert Sullivan reports. Photographed by Steven Klein.

infertile ground



TOXIC TOYLAND
Since World War II, an estimated 80,000 chemicals have been introduced—in plastic toys, lawn-care products, and cleaning agents. Jil Sander dress. Earrings by Tom Binns. Hair, Ben Skervin, using Aveda; makeup, James Kaliardos for L'Oréal. Details, see In This Issue.
Sittings Editor: Phyllis Posnick.

You don't want to seem paranoid. You don't want your wife and kids to think you are crazy, or any crazier than you already are. But then there you are, rifling through the bathroom, reading the backs of face creams and shampoos, wondering about the long list of ingredients. And once you start looking, it's easy to feel as if your life has been invaded by chemicals, as if there's almost nothing you can do about it. You want to ignore the fact, for instance, that your son's deodorant is suspect. Then you learn that it's associated with male reproductive disorders. You want your daughter to just grab a water bottle as she leaves for a bike ride; you don't want to freak her out by telling her that she could be risking her chances of someday becoming a mother. Then you read about the increase in impaired menstruation that results from long-term exposure to the chemicals in many plastics. You may even try to ignore the scores of chemicals that we breathe and ingest and absorb, that stay with us, in some cases, even after industry-wide regulations phase them out. The fact is, no matter how much you try not to, you begin to feel paranoid. You start to see the more and more undeniable truth that the future of our species depends not just on our buying organic strawberries or carrying a canvas bag to the farmer's market. You see that the fertility of our children (if not ourselves) hinges on changes we must make to our immediate environment, the very places in which we live.

The story is slowly creeping out of the statistics. As is already well known, women in their late 30s and 40s are increasingly having difficulties getting pregnant. Yes, some part of this statistic can be attributed to timing, to that thing people still talk about hearing even if they can't, the so-called biological clock. Likewise, women in their early to mid-30s are also reporting difficulties. It is sometimes argued that this uptick in what scientists refer to as impaired fecundity is because young women talk more freely about a problem—infertility—that not too long ago was deemed more personal failure than medical condition. Aside from the fact that women of all ages are experiencing increases in infertility, nothing is particularly startling; it's nowhere near a scene out of *Children of Men,* the film set in postapocalyptic England, where men and women are, by virtue of the degraded world, infertile.

But then comes the figure that has recently grabbed the attention of public health officials, fertility experts, and even elected representatives: Women in their 20s are more likely than ever to report difficulties getting pregnant. These are the very women who, Biology 101 would tell you, ought to have the least difficulty reproducing, and yet now they face the most dramatic increases in fertility problems—a 42 percent jump between 1982 and 1995, according to the National Center for Health Statistics. And that's not all the bad news, because at the same time, sperm rates have reportedly fallen, especially in places where, at least one theory goes, men might be exposed to pesticides. You try to be a decent parent and feed your children expensive milk and vegetables that are free from chemicals, and then you look at your son and realize that statistically he is likely to have half the sperm count of his father.

The figure that makes me especially paranoid is the one that is least likely to make headlines and at the same time is potentially the most daunting: In up to 10 percent of all infertility cases, doctors can't say why there is difficulty, who or what is to blame. Researchers know only one thing for certain: Infertility is rising. "It's kind of like what we went through with breast cancer, where it was affecting one in nineteen people, then one in fifteen, then one in twelve, then one in ten people," says Joseph Isaacs, the former director of Resolve: The National Infertility Association. "Now we're looking at that kind of ratio in fertility: one in eight, to be exact."

The first thing doctors do, of course, is examine the patient. But after so many people start to show up with strikingly similar problems, they look at their patients as a group—or, more broadly, at their environment. And so, scientists are looking at our food and water and homes for clues, and they are beginning to discover some bad news. The blame for our infertility problems is increasingly linked to the rise in chemicals that are ubiquitous in our lives. "If we were talking five years ago, we would have said, 'Oh, it's just a couple of people having trouble getting pregnant,'" says Charlotte Brody, executive director of Commonweal, a nonprofit health and environmental-research institute based in Bolinas, California. "But now there's enough data to say infertility has really gone up, and chemicals are part of the problem."

What are the chemicals in question? These are the substances used to make creams creamy, to make plastics durable

Fertility, while still considered a private matter, is becoming more a concern of public health, and the chief suspect in the decline in fertility may be the chemicals that are practically the fabric of our everyday lives. The first indications arose less than a decade ago, thanks in large part to the groundbreaking work of Theo Colborn, a former pharmacist who got a Ph.D. in zoology at 58. She noticed pervasive fertility problems in wildlife along the Great Lakes. Her book *Our Stolen Future,* co-written with Dianne Dumanoski and John Peterson Myers, helped to jump-start congressional action when it was published in 1996. "The possible consequences of widespread hormone disruption are immense and irreversible," Colborn wrote.

The problem with our fertility, Colborn saw, may have begun with what we have dumped into our environment over the past 50 years—the synthetic compounds that now lace our water and our landfills. Since World War II, an estimated 80,000 chemicals have been introduced—in plastics, in lawn-care products, in the products that we put on our skin and hair. And now the evidence that these chemicals are affecting our fertility is building—even certain in a few cases. At the moment, the majority of the data comes from animal tests, which are disparaged by some chemical companies—but a number of experts in the field argue that there is more than enough information to warrant precautionary measures. "We're all awash in a sea of chemicals," says Sarah Janssen, M.D., Ph.D., a scientist with the Natural Resources Defense Council. "People continue to be exposed while we try and figure out how to test things."

The chemicals of primary concern are a group of synthetic compounds known as endocrine disrupters. Endocrine disrupters are so named for their ability to mimic or block hormones that regulate many of the body's functions. Small changes to this intricate system of hormonal signals can result in big problems. Take bisphenol A, also known as BPA, widely used in plastics and dental fillings. BPA has been found in more than half the samples of canned fruit, vegetables, soda, and baby formula on supermarket shelves, and 95 percent of Americans have BPA in their urine, reports the CDC.

According to its critics, BPA migrates from your plastic bottle into the water or soda or juice it holds. The industry that manufactures BPA maintains that it is harmless, especially in small doses. But according to the latest non–industry sponsored studies, BPA masquerades as a healthy hormone while causing havoc in your body. BPA has been shown in animal studies to cause prostate cancer and malformed genitals, and to harm mammary-gland development in females at puberty. Low-level fetal exposure in animals has been linked to breast cancer, and a recent study in Japan traced the chemical to an increased risk of miscarriage.

The cumulative incriminating data about BPA and other chemicals prompted Greenpeace to issue a politically pioneering report last year that read, in part, "Although not proven beyond doubt, there is increasing evidence of a possible link between the synonymous rise of reproductive health problems [in humans] and the rise of our exposure to many chemicals."

When I'm thinking about my kids' health, I tend to think parochially and look just in our cupboards, to think just about the choices our family makes. But science is about seeing big. The new way of considering these chemicals has a lot to do with what happened with the drug widely known as DES—the synthetic estrogen diethylstilbestrol.

DES was given to women between the late 1930s and 1971, to prevent miscarriage and premature births. During that time, it was considered safe, though studies as early as the late 1930s showed it caused cancer in rodents. As it turned out, DES was ineffective in preventing miscarriage, and it wasn't until 1971 that women whose mothers had taken the drug discovered that they were more likely to have a relatively rare vaginal and cervical cancer. It also raised the possibility of fetal origins of an adult disease; later research suggested that sons born of those daughters were more likely to have undescended testes and low sperm counts. DES daughters suffer more ectopic pregnancies (i.e., the egg develops in the Fallopian tubes instead of the uterus) and are at least twice as likely to suffer fertility problems. In other words, DES adversely affected the fertility of the mother *and* her offspring.

A parallel realization came in the study of sperm, most notably in the work of Shanna Swan, Ph.D. An epidemiologist and biostatistician at the University of Rochester School of Medicine, where she is director of the Center for Reproductive Epidemiology, Swan has spent the past two decades studying environmental reproductive risks. In the early nineties, as a lead investigator for the California Department of Health, Swan showed a statistical relationship between a Silicon Valley cluster of miscarriages and a semiconductor plant leaking toxic chemicals into the drinking water; the level of one particular contaminant found in the water was below the level that federal regulations deemed safe at the time. "That was my introduction to the environment's effect on reproductive health," she says.

In 1992, European scientists documented a decline in sperm counts throughout the Western world in a groundbreaking report, and three years later Swan was called in to examine the results. She subsequently confirmed the results for American men and further showed an even sharper decline in some European countries. She also demonstrated that where a man lived might have a substantial effect on his sperm count and quality. In 2003, while at the University of Missouri–Columbia, Swan reported that men in rural Missouri had a 42 percent lower sperm count than men in urban Minneapolis (as well as places like New York). You might think men in the country would be healthier, but outside the city you'll find traces of chemicals associated with agricultural pesticides. "It showed us that yes, there is a significant variation in sperm quality," she says.

Swan is currently heading up the Study for Future Families, a multicenter study, now in its seventh year, that looks at the environmental and lifestyle factors that affect the reproductive health of men, women, and children. Most recently, she and a team of scientists published a paper that showed that prenatal exposure to phthalates—one type of endocrine disrupter found in plastic bottles and toys, among other things—adversely affects genital development in boys.

What are the chemicals in question? Where are they found? These are substances used to make creams creamy, to make plastics durable. Do you remember the taste of water from a hose in the summer? That tangy taste is the phthalates used to give the plastic in the hose flexibility. In the case of pregnant women, these chemicals are particularly troubling, as they can cross the placenta. The Environmental Working Group, an advocacy organization, ranks the level of phthalates and related chemicals (see cosmeticsdatabase.com). While you'd be hard pressed to find the names of these chemicals listed as ingredients because companies are not legally required to do so, the primary suspects are:

PHTHALATES

Where: Used as gelling agents and fixatives in cosmetics and grooming products; used to soften plastics—in drug capsules, for example, and infants' toys like bathtub books.
Risks: When a fetus is exposed to phthalates (pronounced *thal*-ates), they may cause malformation of the reproductive tract in males and decreased semen quality.

BISPHENOL A (BPA)

Where: Found in baby bottles, CDs, dental sealants, and the linings of food and beverage cans and winemakers' casks.
Risks: Animal studies have linked BPA to prostate cancer and decreased semen quality. In females, it may alter the onset of puberty and cause polycystic ovaries. Phthalate exposure during adulthood may lead to menstrual irregularities and to miscarriage.

ALKYPHENOLS (SURFACTANTS)

Where: In cleaning solutions and paints; used in detergents, fragrances, and air fresheners.
Risks: May reduce male fertility; are thought to mimic estrogen.

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(continued from page 277) up painting for full-time teaching. But once again ambition called the shots. In new paintings such as *The End of the All Night Movie* (1978) and *Save the Last Dance for Me* (1979), she struck a darker emotional note with contrasting squares of pink and black paint.

Returning to New York in late 1979, she went through a rough few years. She broke up with a new boyfriend, left Holly Solomon, drank too much, felt alienated from the downtown scene. Neo-expressionism was in, and the new stars were all macho males. "The whole art enterprise changed from being this underground, countercultural activity to being very professional and career-oriented. Those guys knew how to negotiate and market and self-promote." Heilmann didn't do much painting during the next few years, although 1983 produced the stunning *Rosebud,* whose blotches of dripping red on white look like open wounds. At some point she quit drinking. "The passion and the fear went out of my life and into the work."

The arc of Heilmann's career took a sharp upward swing when she joined Pat Hearn's East Village gallery in 1986. She was the only female in a lively group of younger male artists that included Philip Taaffe and Peter Schuyff, and for the first time, she had a really close and productive relationship with a dealer who adored her work. *Rosebud* and *The Beach House* were in her first show there, in 1986. Over the next twelve years, Hearn gave her seven solo shows, helped her connect with Hauser & Wirth in Zurich (and now London), and sold enough work to ease the financial worries. She also welcomed Heilmann into what seemed like a real family of artists and friends, something she hadn't experienced since the seventies. Hearn's premature death, in 2000, followed two years later by the death of Hearn's husband, Colin de Land, was a heavy blow. One of the things Heilmann plans to do one day is put up a prefab building on her Long Island land, "and when I'm not on the planet anymore, this will be a museum that honors the eighties art world that Pat and Colin represented."

Heilmann now shows with 303 Gallery in New York, and her prices are rising steadily. The upcoming retrospective may even turn her into an art star after all these years. But Heilmann has been around long enough to know that what matters most is just doing her work and being with her friends. "My picture of reality got reconfigured," she tells me. "I hardly ever get jealous of anyone now. Going around and doing all this visiting-artist stuff for the last 30 years, I've connected with so many different generations of young people. And when they say things like Rachel Harrison said to me the other day, that she got inspired by my color, I just about fainted. Seeing yourself as a part of the community for almost 50 years—that's a very rich and wonderful aspect of this practice." □

SMOKE DREAMS

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conspired to prevent this, but when Chris arrived at the Big Apple Barbecue Block Party this year, I stayed up with him until one in the morning while he prepared more than 70 shoulders (each weighing between seventeen and eighteen pounds) for the following day. For competitions and events such as this, Chris injects a thin solution of apple juice, vinegar, sugar, salt, and spices deep into the shoulder (a procedure allowed by the Memphis competition rules, which on the other hand prohibit the use of anything but wood and charcoal for fuel), then rubs the surface of the shoulders with his own spice mixture and loads them onto the revolving shelves of his shiny black Jedmaster pit. When Chris married into the family, he learned barbecue from a man at Big Bob Gibson's who had been taught by Mr. Gibson himself. You might say that I learned from a man who learned from a man who learned from Big Bob Gibson.

The special feature of the Jedmaster is that the charcoal is distributed around the outside of a heavy metal form fashioned more or less in the shape of a racetrack. Chunks of wood are arranged over the charcoal (Chris uses pignut hickory or shagbark hickory, but avoids red hickory, which he feels is too strong). The charcoal is lighted in only one place, and for the next eight or twelve hours, the fire travels slowly around the racetrack, giving off an even heat and not requiring refueling. Nonetheless, Chris told me, he and his family had worked out a schedule so that every two hours, different team members would leave their hotel, walk down to Madison Square Park, check on the pits, and make sure the temperatures hadn't moved from the ideal 225° F. The lore of barbecue is full of reminiscences of long nights spent with buddies around a pit the night before a competition. The divorce rate among pit masters is said to be exceptionally high.

Next Wednesday, Jen or Michael from Flying Pigs Farm in upstate New York near Saratoga Springs will drive down with a vast 24-pound shoulder from a Tamworth hog, which I'll pick up at the Union Square Greenmarket. I think I am dreading that moment. At a little under an hour a pound, that shoulder and I will be inseparable for 20 hours.

While I'm there, maybe I'll buy several of the fantastic Belle Rouge chickens from Violet Hill Farm. I have always derided chicken as a candidate for real barbecue. Chicken doesn't need to be cooked low and slow to become tender, and I've never liked smoked chicken, which I had eaten only cold. Now I take it all back. The process is not barbecue; you would call it smoke roasting, and it is scrumptious. You don't need a professional pit to do it, just a regular covered grill with an accurate thermometer. So, set up your grill for indirect cooking as follows: Make a smoky fire on one side of the grill with lump charcoal and wood chips that have been soaked in water. On the other side, where more charcoal would go, place a disposable aluminum pan filled with water—to catch the drippings and create moisture. Rub one or more three- to four-pound chickens liberally with salt and black pepper and put them on the grill, but only over the aluminum pan and as far from the fire as possible. Cover and maintain temperatures between 240 and 250° F by opening and closing the air vents. Cook the chickens for between one-and-a-half and two hours, until the temperature in the thigh measures 170° F. That's it. Someone who just happened to drop by when my last batch of chickens emerged from the pit said they were the best chickens she had ever tasted. When they had cooled, there was no longer anything special about them.

Some of you may feel secretly envious of me for having fulfilled what seems to have been my main goal in life. It took all the money we had in the bank plus a huge loan, and we still have nowhere to live but our old broken-down loft. We travel six blocks downtown whenever outdoor cooking is on the menu—like going to the beach for a cookout. And for nearly two years now, I've smoked some truly serious barbecue in my own backyard. □

INFERTILE GROUND

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POLYBROMINATED DIPHENYL ETHERS (PBDES)

Where: Found in the flame retardants in furniture, clothing, and electronics.
Risks: May reduce male fertility, testicular size, and sperm quality.

ARTIFICIAL MUSKS

Where: Used in detergents, fragrances, and air fresheners.
Risks: Linked to hormonal changes.

If you look at the information published by the chemical industry, most of the

compounds appear harmless, especially in doses typically used in, say, a single plastic bottle. "Over four decades of extensive safety research on BPA shows that consumer products made with BPA are safe for their intended uses and pose no known risks to human health," an industry statement reads. (A study in 2004 by Frederick von Saal, Ph.D., professor of reproductive endocrinology at the University of Missouri–Columbia, showed that of the 104 studies on BPA done by independent researchers, 94 found adverse effects and ten found no effects; of the eleven studies sponsored by the BPA industry, none showed adverse effects.) But as Shanna Swan is finding, thinking in terms of lethal doses misses the point. Scientists are beginning to wonder about the long-term consequences of living with low levels of toxins, particularly at key developmental times—in utero or during childhood or puberty. Some of these chemicals can stir trouble at levels that are 2,000 times below the EPA's safety guideline.

Sometimes the outcomes of contact with chemicals can seem counterintuitive. A University of Missouri study showed that in male mice exposed in the womb to low doses of BPA, the prostate gland enlarged. Exposed to intermediate doses, the prostate remained the same size; exposed to high doses, the prostate shrank. "I think we have to change the way we look at exposures," Swan says from her office in Rochester. "We have to look not just at big exposures in the short term but little exposures over a long time."

Politically, petrochemical profits seem to work like endocrine disrupters, adversely disrupting our governmental regulations. In 2002, $5.3 billion was spent to manufacture the BPA that went into water bottles, baby bottles, food-can linings, and dental sealants alone. Meanwhile, do you know many people who would readily give up plastic? Try packing a lunch without plastic containers. And there is the inherent safety that plastic offers: It's problematic to replace shatterproof plastic baby bottles with glass. Nonetheless, there seems to be a demand: After newspapers reported on the issue, stores on the West Coast sold out of glass baby bottles.

Waiting around for government testing is looking more and more detrimental. "If the only way we can have a really powerful economy is by making chemicals that destroy the atmosphere, the seas, the environment, then that's not an economy I want to be a part of," says Carolyn Raffensperger, an environmental lawyer and the executive director of the Science and Environmental Health Network. Raffensperger is a chief proponent of the precautionary principle, a moral and political proposition that places the burden of proof on the chemical industry—to demonstrate that the compound is safe (or that there is no safer alternative) *before* it is put into action or the marketplace. In a sense, the pharmaceutical industry already works along precautionary-principle lines: Medicines are tested extensively before they are approved for use and monitored once on the market. In the chemical industry, compounds are considered safe until proven dangerous, and only when determined dangerous are they banned.

Some hope that business will make adjustments on their own. "In the absence of government, companies are saying, How can we make our products a little more safe?" says Charlotte Brody, executive director at Commonweal. Procter & Gamble has removed dibutyl phthalate from its products, while Revlon, Unilever, and L'Oréal have all said that they will not use any chemicals that are already banned in Europe. Kaiser Permanente, the West Coast medical-managed-care company, has stopped using products made with phthalates in neonatal intensive-care units.

A few local governments have attempted to step in where the federal government has yet to venture. San Francisco banned toys for children under three made with high levels of endocrine disrupters, like soft plastic toddler books or teething devices, items that have been called "toxic lollipops." Last year, the *San Francisco Chronicle* tested a rubber ducky with thirteen times the city-allowed level of the phthalate DEHP. (Chemical manufacturers sued the city to block the law.) Other local governments have followed suit: A half dozen state legislatures are considering passing similar regulatory acts. Internationally, Japan has phased out the use of BPA in food cans, and the European Union has banned some endocrine disrupters and launched a large-scale long-term study of the effects of many of these chemicals.

The U.S. Environmental Protection Agency, however, has gone in the opposite direction. "With all these reports of deformed penises and sperm counts lessened and with these chemicals being used in baby bottles, we don't know exactly what it means, but it could affect future generations, and now what happens?" asks the NRDC's Sarah Janssen. "The EPA proposes to raise the safe level [of dibutyl phthalate use] threefold." In 1999, the NRDC sued the EPA for not testing endocrine disrupters despite a congressional mandate to do so, but the Bush Administration has repeatedly cut funding for testing. Meanwhile, an estimated 1,500 to 2,000 new chemicals a year are brought to market, rarely even listed as active ingredients.

Who wants to panic? For my own part, I spend a little more time researching personal-care products. I've switched from plastic wrap to parchment paper, wash out jam jars rather than use plastic containers, and rely more on water fountains than on plastic bottles. As with so many matters of personal and public health, you have to take the measured approach. That said, health professionals stand between encouraging caution and causing panic, and if there is a problematic tendency toward hysteria, there is a countervailing tendency toward complacency.

"The problem is there aren't any clear answers," says Yale's Hugh Taylor, M.D., an associate professor in the Department of Obstetrics & Gynecology's Reproductive Endocrinology Division, who recently showed that BPA affects fertility in female mice. "Simply throwing everything that is plastic out of your house is too much, and not knowing about it at all is not good. My advice to women is that maybe there are things you can avoid while being pregnant. It's not that hard to avoid plastic water bottles, for instance. Or canned goods with epoxy resins or dental sealants. I think it's OK to exercise caution." Investigations of the effects of multiple endocrine-disrupter exposures are only just beginning. "That's the one thing we don't have from any of these experiments," Taylor says. "We don't even know what we are exposed to. In the real world, it's never a single exposure."

In the real world of real patients being advised and treated with precaution, Linda Giudice, M.D., Ph.D., has noticed that pediatricians, as a group, have been quick to respond to the latest research by teaching parents how to minimize chemical exposure. "You're never going to get rid of every exposure," says Giudice, who is chair of the Obstetrics, Gynecology and Reproductive Sciences Department at the University of California in San Francisco. But she hopes a turning point on the issue is imminent. "There has not yet been a champion of environmental health on the level of Al Gore. I think our day is coming. It's the health of our children. It's the health of generations." □