Anne Merewood

It didn't make sense. Kate Malone's* first pregnancy had gone so smoothly. Yet when she and her husband Paul* tried to have a second child, their efforts were plagued by disaster. For two years, Kate couldn't become pregnant. Then she suffered an ectopic pregnancy, in which the embryo began to grow in one of her fallopian tubes and had to be surgically removed. Her next pregnancy heralded more heartache—it ended in miscarriage at four months and tests revealed that the fetus was genetically abnormal. Within months, she became pregnant and miscarried yet again. By this point, some four years after their troubles began, the couple had adopted a son; baffled and demoralized by the string of apparent bad luck, they gave up trying to have another child.

"We had been to the top doctors in the country and no one could find a reason for the infertility or the miscarriages," says Kate. Soon, however, thanks to a newspaper article she read, Kate uncovered what she now considers the likely cause of the couple's reproductive woes. When it all started, Paul had just been hired by a manufacturing company that used a chemical called para dichlorobenzene, which derives from benzene, a known carcinogen. The article discussed the potential effects of exposure to chemicals, including benzene, on a man's sperm. Kate remembered hearing that two other men in Paul's small office were also suffering from inexplicable infertility. Both of their wives had gone through three miscarriages as well. Kate had always considered their similar misfortunes to be a tragic coincidence. Now she became convinced that the chemical (which has not yet been studied for its effects on reproduction) had blighted the three men's sperm.

Paul had found a new job in a chemical-free workplace, so the couple decided to try once more to have a baby. Kate conceived immediately—and last August gave birth to a healthy boy. The Malones are now arranging for the National Institute for Occupational Safety and Health (NIOSH), the federal agency that assesses work-related health hazards for the public, to inspect Paul's former job site. "Our aim isn't to sue the company, but to help people who are still there," says Kate.

The Malones' suspicions about sperm damage echo the concerns of an increasing number of researchers. These scientists are challenging the double standard that leads women to overhaul their lives before a pregnancy—avoiding stress, cigarettes and champagne—while men are left confident that their lifestyle has little bearing on their fertility or their future child's health. Growing evidence suggests that sperm is both more fragile and potentially more dangerous than previously thought.

"There seems to have been both a scientific resistance, and a resistance based on cultural preconceptions, to accepting these new ideas," says Gladys Friedler, Ph.D., an associate professor of psychiatry and pharmacology at Boston University School of Medicine.

But as more and more research is completed, sperm may finally be stripped of its macho image. For example, in one startling review of data on nearly 15,000 newborns, scientists at the University of North Carolina in Chapel Hill concluded that a father's drinking and smoking habits, and even his age, can increase his child's risk of birth defects ranging from cleft palates to hydrocephalus, an abnormal accumulation of spinal fluid in the brain. Other new and equally worrisome studies have linked higher-than-normal rates of stillbirth, premature delivery and low birthweight (which predisposes a baby to medical and developmental problems) to fathers who faced on-the-job exposure to certain chemicals. In fact, one study found that a baby was more likely to be harmed if the father rather than the mother worked in an unsafe environment in the months before conception.

The surprising news of sperm's delicate nature may shift the balance of responsibility for a newborn's wellbeing. The research may also have social and economic implications far beyond the concerns of couples planning a family. In recent years a growing number of companies have sought...
to ban women of childbearing age from jobs that entail exposure to hazardous substances. The idea is to protect the women's future children from defects—and the companies themselves from lawsuits. Already, the “fetal protection policy” of one Milwaukee-based company has prompted female employees to file a sex discrimination suit that is now before the U.S. Supreme Court. Conversely, if the new research on sperm is borne out, men whose future plans include fatherhood may go to court to insist on protection from hazards. Faced with potential lawsuits from so many individuals, companies may be forced to ensure that workplaces are safe for all employees.

Sperm und Drang
At the center of all this controversy are the microscopic products of the male reproductive system. Sperm (officially, spermatozoa) are manufactured by spermatagonia, special cells in the testes that are constantly stimulated by the male hormone testosterone. Once formed, a sperm continues to mature as it travels for some 80 days through the prostate gland, where it is expelled in the next seminal fluid that buoys sperm. But more researchers are becoming convinced that chemicals can inflict their silent damage directly on the sperm itself.

The Chemical Connection
The most well-known—and most controversial—evidence that chemicals can harm sperm comes from research on U.S. veterans of the Vietnam war who were exposed to the herbicide Agent Orange (dioxin), used by the U.S. military to destroy foliage that hid enemy forces. A number of veterans believe the chemical is responsible for birth defects in their children. The latest study on the issue, published last year by the Harvard School of Public Health, found that Vietnam vets had almost twice the risk of other men of fathering infants with one or more major malformations. But a number of previous studies found conflicting results, and because so little is known about how paternal exposure could translate into birth defects, the veterans have been unsuccessful in their lawsuits against the government.

Scientific uncertainty also dogs investigations into other potentially hazardous chemicals and contaminants. "There seem to be windows of vulnerability for sperm: Certain chemicals may be harmful only at a certain period during sperm production," explains Donald Mattison, M.D., dean of the School of Public Health at the University of Pittsburgh. There isn't enough specific data to make definitive lists of "danger chemicals." Still, a quick scan of the research shows that particular substances often crop up as likely troublemakers. Chief among them: lead, benzene, paint solvents, vinyl chloride, carbon disulphide, the pesticide DBCP, anesthetic gases and radiation. Nor surprisingly, occupations that involve contact with these substances also figure heavily in studies of sperm damage. For example, men employed in the paper, wood, chemical, drug and paint industries may have a greater chance of siring stillborn children. And increased leukemia rates have been detected among children whose fathers are medical workers, aircraft or auto mechanics, or who are exposed regularly to paint or radiation. In fact, a study of workers at Britain's Sellafield nuclear power plant in West Cambria found a sixfold leukemia risk among children whose fathers were exposed to the plant's highest radiation levels (about 9 percent of all employees).

Workers in "high-risk" industries should not panic, says Savitz. "The credibility of the studies is limited because we have no firm evidence that certain exposures cause certain birth defects." Yet it makes sense to be watchful for warning signs. For example, if pollution levels are high enough to cause skin irritations, thyroid trouble, or breathing problems, the reproductive system might also be at risk. Another danger signal is a clustered outbreak of male infertility or of a particular disease: It was local concern about high levels of childhood leukemia, for instance, that sparked the investigation at the Sellafield nuclear plant.

The rise in industrial "fetal protection policies" is
Johnson Controls defends its factory areas where lead exceeded a specific level. But further research into chemicals' effects on current occupational safety standards for humans.

The rats were then mated with females who had not been exposed at all. Result: The offspring showed clear defects in brain development. Johnson Controls claims that evidence linking fetal problems to a father's contact with lead is insufficient. But further research into chemicals' effects on sperm may eventually force companies to reduce pollution levels. Since both sexes can hardly be banned from the factory floor, says Mattison: "The workplace should be safe for everyone who wants to work there, men and women alike!"

**Father Time**

Whatever his occupation, a man's age may play an unexpected role in his reproductive health. When researchers at the University of Calgary and the Alberta Children's Hospital in Canada examined sperm samples taken from 30 healthy men aged 20 to 52, they found that the older men had a higher percentage of sperm with structurally abnormal chromosomes. Specifically, only 2 to 3 percent of the sperm from men between ages 20 and 34 were genetically abnormal, while the figure jumped to 7 percent in men 35 to 44 and to almost 14 percent in those 45 and over. "The findings are logical," says Renée Martin, Ph.D., the professor of pediatrics who led the study. "The cells that create sperm are constantly dividing from puberty onwards, and every time they divide they are subject to error."

Such mistakes are more likely to result in miscarriages than in unhealthy babies. "When part of a chromosome is missing or broken, the embryo is more likely to abort as a miscarriage (than to carry to term)," Martin says. Yet her findings may help explain why Savitz's North Carolina study noted a doubled rate of birth defects like cleft palate and hydrocephalus in children whose fathers were over 35 at the time of conception, no matter what the mothers' age.

Currently, there are no tests available to predict sperm likely to cause genetic defects. "Unfortunately there's nothing offered, because [the research] is all so new," says Martin. But tests such as amniocentesis, alpha fetoprotein (AFP) and chorionic villus sampling (CVS) can ferret out some fetal genetic defects that are linked to Mom or Dad. Amniocentesis, for example, is routinely recommended for all pregnant women over 35 because with age a woman increases her risk of producing a Down's syndrome baby, characterized by mental retardation and physical abnormalities.

With respect to Down's syndrome, Martin's study provided some good news for older men: it confirmed previous findings that a man's risk of fathering a child afflicted with the syndrome actually drops with age. Some popular textbooks will warn that men over 55 have a high chance of fathering Down's syndrome babies. "That information is outdated," Martin insists. "We now know that for certain."

**The Sins of the Fathers?**

For all the hidden dangers facing a man's reproductive system, the most common hazards may be the ones most under his control.

**Smoking.** Tobacco addicts take note: Smoke gets in your sperm. Cigarettes can reduce fertility by lowering sperm count—the number of individual sperm released in a single ejaculation. "More than half a pack a day can cause sperm density to drop by 20 percent," says Machelle Seibel, M.D., director of the Faulkner Centre for Reproductive Medicine in Boston. One Danish study found that for each pack of cigarettes a father tended to smoke daily (assuming the mother didn't smoke at all), his infant's birthweight fell 4.2 ounces below average. Savitz has found that male smokers double their chances of fathering infants with abnormalities like hydrocephalus, Bell's palsy (paralysis of the facial nerve), and mouth cysts. In Savitz's most recent study, children whose fathers smoked around the time of conception were 20 percent more likely to develop brain cancer, lymphoma and leukemia than were children whose fathers did not smoke (the results still held regardless of whether the mother had a tobacco habit).

This is scary news—and not particularly helpful: Savitz's studies didn't record how frequently the fathers lit up, and no research at all suggests why the links appeared. Researchers can't even say for sure that defective sperm was to blame. The babies may instead have been victims of passive smoking—affected by Dad's tobacco while in the womb or shortly after birth.

**Drinking.** Mothers-to-be are routinely cautioned against sipping any alcohol while pregnant. Now studies suggest that the father's drinking habits just before conception may also pose a danger. So far, research hasn't discovered why alcohol has an adverse effect on sperm, but it does suggest that further investigation is needed. For starters, one
study of laboratory rats linked heavy alcohol use with infertility because the liquor lowered testosterone levels. Another study, from the University of Washington in Seattle, discovered that newborn babies whose fathers drank at least two glasses of wine or two bottles of beer per day weighed an average of 3 ounces less than babies whose fathers were only occasional sippers—even when all other factors were considered.

Illicit Drugs. Many experts believe that a man’s frequent use of substances such as marijuana and cocaine may also result in an unhealthy fetus, but studies that could document such findings have yet to be conducted. However, preliminary research has linked marijuana to infertility. And recent tests at the Yale Infertility Clinic found that long-term use led to both very low sperm counts and a greater number of sperm with motion problems.

WHAT A DAD CAN DO

The best news about sperm troubles is that many of the risk factors can be easily prevented. Because the body overhauls sperm supplies every 90 days, it only takes a season to get a fresh start on creating a healthy baby. Most experts advise that men wait for three months after quitting smoking, cutting out drug use or abstaining from alcohol before trying to sire a child.

Men who fear they are exposed to work chemicals that may compromise the health of future children can contact NIOSH. (Write to the Division of Standards Development and Technology Transfer, Technical Information Branch, 4676 Columbia Parkway, Mailstop C-19, Cincinnati, OH 45226. Or call [800] 356-4674.) NIOSH keeps files on hazardous chemicals and their effects, and can arrange for a local inspection of the workplace. Because it is primarily a research institution, NIOSH is most useful for investigating chemicals that haven’t been studied previously for sperm effects (which is why the Malones approached NIOSH with their concerns about paradichlorobenzene). For better-known pollutants, it’s best to ask the federal Occupational Safety and Health Administration (OSHA) to inspect the job site (OSHA has regional offices in most U.S. cities).

There is also advice for men who are concerned over exposure to radiation during medical treatment. Direct radiation to the area around the testes can spur infertility by halting sperm production for more than three years. According to a recent study, it can also triple the number of abnormal sperm the testes produce. Men who know they will be exposed to testicular radiation for medical reasons should consider “banking” sperm before the treatment, for later use in artificial insemination. Most hospitals use lead shields during radiation therapy, but for routine X-rays, even dental X-rays, protection might not be offered automatically. If it’s not offered, patients should be sure to request it. “The risks are really, really low, but to be absolutely safe, patients—male or female—should always ask for a lead apron to protect their reproductive organs,” stresses Martin.

Though the study of sperm health is still in its infancy, it is already clear that a man’s reproductive system needs to be treated with respect and caution. Women do not carry the full responsibility for bearing a healthy infant. “The focus should be on both parents—not on ‘blaming’ either the mother or the father, but on accepting that each plays a role,” says Friedler.

Mattison agrees: “Until recently, when a woman had a miscarriage, she would be told it was because she had a ‘blighted ovum’ [egg]. We never heard anything about a ‘blighted sperm.’ This new data suggests that both may be responsible. That is not unreasonable,” he concludes, “given that it takes both an egg and a sperm to create a baby!”