

Miscarriage of Justice

A decade after the first warnings that glycol ethers threatened reproductive health, the semiconductor industry is finally cleaning up its act

BY BOB JOHNSON

BY LATE 1987, after 15 years in semiconductor production work, Lynda Burgess first discovered her job was threatening her health. Burgess was employed in a small clean area in the Xerox research and development facility off Page Mill Road in Palo Alto.

Her job at Xerox involved sitting at a camera about the size of a kitchen stove and looking through a microscope at wafers about the size of a pancake. Once the wafer was properly lined up in the scope, she would snap a picture.

Burgess did her job under the same conditions as some 35,000 semiconductor production area employees—nearly all of them women—who work with a variety of chemicals as they build the foundation of the high-tech industry. Among these substances are ethylene-based glycol ethers, clear, generally odorless, but sometimes sweet-smelling liquids that serve many purposes. Semiconductor firms use them in the production of computer wafers. The chemicals are also commonly found in such household items asinks and paints and in automotive coolant.

A semiconductor plant's clean area is painstakingly designed to prevent any foreign matter from contaminating the product. Clean-area workers wear body suits—not to shield themselves from chemicals, but to protect the wafers from human contamination. It's dust-free and particle-free," Burgess said, describing her former work area. "There's no way to take the odor out of the air, but it doesn't affect the product, so they don't worry about it."

"There would be headaches every once in a while. I always had headaches," Burgess recalled. These occasional aches were the only clues she'd had that her job

might be hazardous. "They'd let you go out a while until [the headache] cleared up. Then you'd come back. You always wondered what it was."

Though she wondered about the dangers posed by chemicals she was using, Burgess understood—as thousands of other workers would land her in trouble.

"At the time, you didn't ask any questions, you just don't," she said. "You pick up a bottle and use it. Until I worked at Xerox, I didn't even see the bottles. They'd just bring the stuff in, and you don't have a clue what you're working with."

Burgess worked for more than a decade in the production areas of local high-tech firms without hearing a word from anyone in management about any potential hazards from the commonly used chemicals. She took her first job at Signetics Corp. in Sunnyvale right after graduating from Prospect High School 20 years ago. Three years later, she moved on to Intel, still in Santa Clara, where she met her future husband; then she continued migrating through high-tech firms until she arrived at Xerox in 1986.

In late 1987, Xerox managers assembled the women of the clean area and told them about a Digital Equipment Corp. study showing significantly higher miscarriage rates among women exposed to glycol ethers. Burgess and her husband were trying to have a baby when she went to that meeting. Her first son, Patsy, was already 2 at the time, and he seemed healthy enough.

"About two weeks later," she recalled, "I discovered I had miscarried. We were trying to make a child, but I didn't even know I was pregnant."

The incident apparently left not even a blip on the Xerox corporate memory screen, though Burgess reported it to management.

"We have not had any indication of any problem because of glycol

ethers," said Dave Ham, who took over as manager of environmental health and safety at the Xerox Palo Alto Research Center five years after Lynda Burgess miscarried. Ham expressed surprise to learn from a reporter that an employee in the clean area had miscarried.

According to Ham, the company has decided against making special provisions to protect pregnant workers. "Our policy is that we don't make exceptions for any employee," he said. "If you make the place safe for any employee, you don't have to have a transfer policy."

The company did have a temporary bout of caution when Burgess got pregnant again not long after her miscarriage. She was moved to a job outside of the clean area until her second son, Steven, was born. Not long after, however, Burgess again became pregnant. By her account, management declined to transfer her. "When I got pregnant again with Jessica a year later, they refused to move me out of the clean area," she said. "I asked them to, and they refused. They said there wasn't enough evidence."

Burgess stayed at Xerox—and stayed in the clean area—until Jessica was born. She then asked the company for a year off to be with her infant daughter. Xerox said no. And she quit.

Now no longer working in the semiconductor industry, Burgess feels free to tell her story. She is married to a chemist and doesn't intend to return to high-tech production rooms again. According to worker-safety activists, however, many women who still work in the industry are reluctant to go public with their complaints.

GLYCOL ETHERS appeared prominently in the news when two studies on exposure to the chemical were released in late 1992. The studies turned scrutiny on the industry's use of glycol ethers, but

they were certainly not the first reports of possible hazards; semiconductor executives had been warned more than a decade before that glycol ethers might cause reproductive tragedy.

In December 1992, a team of medical researchers from UC-Davis released the results of a three-year, \$3.5 million study which found a correlation between exposure to glycol ethers and infertility and miscarriage.

At the behest of the San Jose-based Semiconductor Industry Association (SIA), the researchers sampled 15,000 workers from 14 chip plants across the country. The Davis study found that women who were exposed to glycol ethers had a pregnancy rate that was 30 percent lower than those who were not. And those who became pregnant were 40 percent more likely to suffer miscarriages. (The average rate of miscarriage in women was 13 percent in 1988, according to the National Center for Health Statistics.)

Even more stunning results were found in a Johns Hopkins study at two IBM semiconductor plants that was released two months earlier than the Davis study. One out of three pregnant women exposed to glycol ethers at IBM miscarried.

The short-lived flurry of bad publicity stirred up by the Davis and IBM studies prodded industry leaders to assure the public that workers' safety would be protected. "The days of ethylene-based glycol ethers are numbered," Semiconductor Industry Association President Andrew Procassini announced in a statement issued along with the Davis study results. "We have consistently taken steps to protect the work force from potential exposure to harmful chemicals."

The SIA's public relations effort touted a proud history of concern for worker health and safety. The semiconductor industry's record of 4.5 illnesses or injuries per 100 workers places it fifth in terms of safety among the 234 durable-goods manufacturing industries surveyed by the U.S. Bureau of Labor Statistics.

And the association is quick to point out that both the IBM and UC-Davis studies were funded by the industry after the 1986 Digital study that Burgess heard about at Xerox. Since the two latest studies were released, many semiconductor firms have indicated they will curtail use of glycol ethers.

Xerox has already discontinued the use of one glycol-ether compound and hopes to find alternatives that will eliminate the need for the chemical. Xerox is also monitoring the air in its clean areas to keep glycol ethers well below the recommended limits, but, according to Ham, the studies suggest air monitoring is an ineffective precaution.

The industry leader in going public with a plan to protect workers from glycol ethers has been Santa Clara-based Intel Corp. The chemical is no longer employed in the production of the company's 8-inch wafers, according to Intel

spokesman Howard High, which means it is not used at all in the Santa Clara plant. Intel is also working on a one- to two-year re-engineering plan to eliminate use of the chemical in all processes.

In the meantime, pregnant women are allowed to transfer out of the factory. And women who are attempting to become pregnant are allowed to transfer without a note from their doctor.

Intel's efforts have made the company's name roll easily off the tongues of industry publicists. The company has even earned praise from longstanding industry critics. "Intel is the one company that has stood up in public and said they will phase out [glycol ethers]," Silicon Valley Toxics Coalition Director Ted Smith said.

BUT ALL of the statements issued by industry leaders after the UC-Davis study have taken great pains to avoid mentioning that glycol ethers had become suspect long before the 1986 Digital study. And the media has joined the industry in maintaining silence on a dirty little secret: Executives at every major semiconductor corporation in the country were warned more than a decade ago that they might be subjecting the women in their clean rooms to the dangers of infertility and miscarriage. The women who worked with these chemicals everyday, however, were told nothing of the risks they were taking.

In the early 1970s, the National Institute for Occupational Safety

and Health had already begun testing the effects of glycol ethers on laboratory animals. By the end of the decade, those tests had revealed conclusions startling enough to spur a series of warnings. "Glycol ethers have damaged the reproductive systems of test animals," the California Department of Health Services cautioned in May 1982. "Raising the possibility that they may cause similar effects in humans."

Weeks later, a memorandum issued by SIA Executive Director T.D. Hinkelman advised semiconductor executives nationwide that glycol ethers might pose a reproductive danger. The national institute's report had compiled the results of more than 25 separate studies conducted on the effects of glycol ethers on rats and mice. Those studies indicated that the chemical led to a variety of reproductive ailments, ranging from testicular malformation to embryonic death.

"If areas of significant air exposure are found, engineering controls should be implemented to reduce employee exposure to a concentration of less than 5 ppm. While engineering controls are being implemented to reduce airborne exposures, respiratory protection should be provided and used," Hinkelman's memo recommended. "If areas are found where the possibility for direct skin contact exists, employees should be issued protective clothing, includ-

Continued on next page



Speaking Out: Lynda Burgess, accompanied by her daughters, Jessica, talks about the health problem she experienced while working around glycol ethers.

Hilary Schmitt

Continued from previous page

ing gloves made of either butyl or nitrile rubber."

SHARON HENDERSON was working at an East Coast plant of a large and prestigious high-tech firm when Hinkelman issued his warning. She benefited from the industry's highest standards of safety, the best ventilation equipment and the most impenetrable gloves. But Henderson claims these precautions did little to protect her and the second of her three sons.

"I was taking a bath because I had a sore back, and when I stood up it began," Henderson said, recalling her first miscarriage at the age of 20. Three years later, she said, "the second miscarriage began at night while I was at work. They rushed me to the hospital, but there was nothing they could do."

But when she speaks of her son, Jimmy, Henderson's voice suggests she is still angry enough to take on corporate giants. Jimmy was born with enlarged testicles and a small penis. A few weeks after his first birthday, he had his first hernia operation. When he was 8, Jimmy had permanent sutures stitched into his testicles to prevent them from twisting. Henderson opted for the procedure rather than, as one doctor suggested, having one of her young son's testicles removed. Jimmy is 18 now, and he still complains of pain in the genital area.

"I have a list of the chemical companies, and they're going to know who I am before I'm done," Henderson said. "I read their

reports, and there was nothing about fetal-tissue damage. If I had known, I never would have worked there—I never would have had two miscarriages and my son wouldn't have had problems. I'm furious."

HOW MANY hundreds of women could have been spared tragedy had the industry been more vigilant in its response to the early warnings? Months before Hinkelman issued his warning to semiconductor executives in 1982, the Santa Clara Center for Occupational Safety and Health called for the elimination of glycol ethers. During the decade after that early alarm, the center heard repeatedly from the industry that the studies were too preliminary to warrant action.

"The industry position was that there were only animal studies," center director Amanda Hawes recalls. "They said there's no human data, there's no body count."

By the account of SIA Communications Director Tom Beermann, the decision not to act during the 1980s was a matter of being careful. "The issue is, is there conclusive evidence? We wanted to be as careful as we could," Beermann said. "Eleven years ago, we did not have the evidence we do now."

Even at Intel, response to the early warnings was less than impressive. The company publicized Hinkelman's 1982 memo internally. But when asked if Intel did anything to lessen the dangers after that spokesman High said, "I don't know if we officially did or not." High was candid in stating that

the difference between Intel's current energetic campaign and its lethargic response to earlier warnings was at least in part financially motivated. In 1982, Intel grossed about \$90 million and turned a profit of just \$30 million. A decade of success later, however, Intel's gross had increased to \$5.8 billion. With such financial resources, Intel could now afford to be concerned.

"We sit here now and make a decision that's going to cost tens of millions of dollars, and we have it to invest," High said. "But making a decision that's going to cost you tens of millions when that's all you're making is different. Especially when you have the U.S. government and the chemical industry saying this is one of the safe alternatives."

AFTER THE MOST RECENT studies were released, the Silicon Valley Toxics Coalition and the Santa Clara Center for Occupational Safety and Health assumed leading roles in forming the Campaign to End the Miscarriage of Justice.

The campaign calls for the elimination of glycol ethers from all high-tech plants and suggests that a year should be long enough to get the job done. It also proposes that semiconductor companies match \$10 million in federal funds for Sematech research into safer manufacturing processes—and that, in the interim, workers should be allowed to transfer away from the suspect chemicals with no loss of pay or seniority. The campaign also demands that all non-English-

speaking workers receive information in their own language about the chemicals that surround them.

The campaign names the major local glycol-ether emitters, a list gleaned from the records of the California Environmental Affairs Agency. The list reads like a Who's Who in high tech. Hewlett-Packard Co. took first place in 1991 discharges of glycol ethers into the local sewer system with 48,148 pounds. Sequel Inc. also led the way with 23,095 pounds released into the air. And the toxic waste dump derby was won by VLSI with 180,000 pounds.

Toxics Coalition Director Smith believes that only time will tell how serious high-tech companies are about eliminating glycol ethers. "Their public relations response has been excellent, but their substantive response has been another story," he said.

More than six years ago—after the Digital study—SIA's Procastini pledged: "If there is a real health problem in the industry, we are determined to find it and correct it."

Data on the use of glycol ethers in the semiconductor industry suggest that, despite those fine words, little was done at that time to curb use of glycol ethers.

Twenty-one million pounds of glycol ethers were used by the nation's electronics industry from 1987 to 1990, according to the Environmental Protection Agency. In the three years after Procastini's pledge, according to EPA figures, use of the chemicals in the industry jumped 30 percent.