

Sexy lucre

A San Francisco whore goes to a Nevada brothel [p.31]

Otaku alert

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Virgin spotting

Dilettante keeps up with the Coppola-Jonzes [p.55]

Walking and talking

Rebecca Solnit on the history of walking. In *Lit.*

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GUARDIAN

The Best of the Bay ... Every Week



High tech's toxic toll

Suspicious cancers. Poisoned water. Superfund sites. How the 'clean industry' is killing us. By Christopher D. Cook and A. Clay Thompson [p.16]



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Welcome to San Jose

OSHA Form 101 (Rev. 10-1999)
ACCIDENT NARRATIVE SUMMARY
 OSHA Case No. _____
 Date of Incident: _____
 Location: _____
 Name of Employer: _____
 Name of Supervisor: _____
 Name of Employee: _____
 Name of Investigator: _____

When, How, and Why	Where	What Happened
1. Date and Time	2004/04/16	2004/04/16
2. Job Title	Chip Plant Worker	Chip Plant Worker
3. Job Location	MMC Technology	MMC Technology
4. Description of Incident		
5. Description of Injury		
6. Description of Property Damage		
7. Description of Environmental Damage		

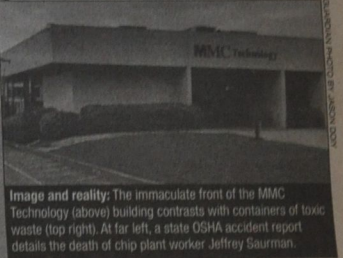
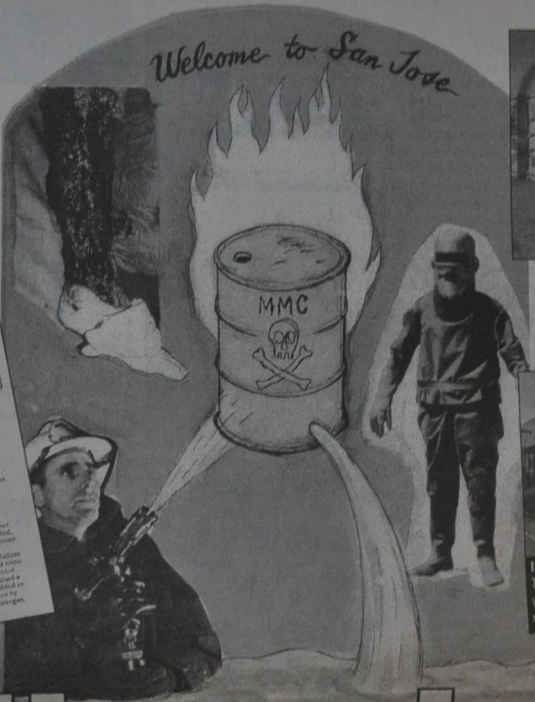


Image and reality: The immaculate front of the MMC Technology (above) building contrasts with containers of toxic waste (top right). At far left, a state OSHA accident report details the death of chip plant worker Jeffrey Saurman.

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Silicon hell

The computer industry prides itself on a "clean" image — but it's actually doing horrible damage to its workers and the environment. *By Christopher D. Cook and A. Clay Thompson. Illustrations by Alex Munn*

On April 16, in Building Three of MMC Technology's CD-ROM plant in San Jose, the lid exploded off a 55-gallon drum, sending up a cloud of toxic chemicals and a splash of nitric acid. The San Jose Fire Department's Hazardous Incident Team evacuated the building and cordoned off the area. Workers, dressed like surgeons in head-to-toe sterile suits, filed out of the plant as the ambulances arrived.

It was a surreal scene. The suits looked like safety equipment, but they are designed primarily to protect the products at the plant from contamination by the workers, not to protect the workers from contamination by the industrial chemicals to which they are regularly exposed.

Nitric acid, one of the most heavily used chemicals in the electronics industry, is very nasty stuff. Inhaling even small amounts can kill a person, filling the lungs with suffocating fluid.

"There were a few people who took a good couple of breaths," fire captain Greg Spence told us. "They were the ones we were worried about."

Seventeen MMC employees ended up in the emergency rooms of three nearby hospitals. Company officials had no comment for this story. The April 16 explosion likely occurred because the acid was mixed with an incompatible chemical, according to the fire department, which is still investigating.

The employees were monitored overnight and re-

leased, apparently unharmed, the next day. But it could have been much worse, Spence said. If the acid had splashed on an unprotected worker, it would have been the stuff horror films are made of.

If nitric acid gets in your eyes, they sizzle and shrink. Where it touches your flesh, the skin dies and eventually becomes black and shrunken, a process called "coagulation necrosis." If it splashes down your throat, you might literally vomit your guts out.

That's not the kind of image most people get when they think about the high-tech industry.

The MMC plant lies on Fortune Drive in northeast San Jose, shadowed by the verdant hills of the Coast range and surrounded by miles and miles of other tech firms. In these parts, where the assembly lines churn out digital hardware 24-7, it's hard to find a commercial building inhabited by a nontech company. But smokestacks, turbines, and the other emblems of heavy industry are rare.

In the public consciousness, high tech is the antithesis of old-fashioned, fossil-fuel-driven industry. The news media normally discuss the new technologies as digitally clean, trafficking in information rather than goods, thriving on creativity rather than muscle.

But that's a mirage. We've spent several months looking into the dark side of Silicon Valley, reviewing hundreds of public documents, visiting dump sites, and interviewing plant workers, lawyers, and activists. What

we've found is a very different story.

Behind the well-paid geeks in cubicles and the sharp-dressed entrepreneurs in an industry that consumes as many resources, uses as many lethal chemicals, and generates as much toxic waste as some of the worst culprits of the pre-Internet age. And both industry workers and the people who live near the plants are feeling the effects: the toxins damage aquatic life in the bay, poison drinking water, and, increasing evidence suggests, kill high-tech industry workers.

The picture is eerily reminiscent of the hype that accompanied the birth of the plastics and petrochemical industries, when the press was so occupied with the consumer wonders of the new technologies that almost nobody paid any attention to the deadly downside. The major Bay Area news media, for example, devote hundreds of pages to stories about the booming tech-driven stock market, the millionaires created in Silicon Valley, and the wonders of the digital age. But there's very little coverage of the human and environmental costs of the waste the computer industry produces.

Toxics are used heavily in all sectors of the e-hardware business. A traditional TV-style monitor comes equipped with several pounds of lead. Flat-screen monitors, the kind you find on laptops, Palm Pilots, and cell phones, replace the lead with greenhouse gases. Makers of circuits and chips guzzle huge quantities of solvents, most of them known health hazards. And hundreds of thou-

sands of tons of those toxic chemicals are released every year into the Bay Area water, air, and ground.

According to the U.S. Environmental Protection Agency's most recent figures, in 1997 the circuit and chip industries — which provide the brain and nervous system of every computer — released, recycled, or dumped 117,545,550 pounds of hazardous chemicals nationwide. And it's safe to say that about 15 percent of the plants that generate that waste are in northern California, mainly in Silicon Valley.

And those 117.5 million pounds are just the tip of the iceberg. The U.S. Department of Commerce reports 2,500 chip, circuit, and monitor plants in operation in the United States that year; only 406 reported their toxic output to the EPA. (See "Garbage In," page 21.)

Tumors the size of grapefruit

On his 50th birthday, in March 1999, Sherron Loanzan had a lot to celebrate. After years of grueling, toxic work making disk drives and electronic components in the "clean room" at IBM's San Jose computer-manufacturing plant, Loanzan had scraped his way up to a job in exports, shipping the company's computer-assembly machinery overseas. He had a beautiful home high in the hills above east San Jose, and his two children were excelling in high school and college. But as Loanzan tried to eat his lunch in the company parking lot that day, he knew something was wrong.

"I was eating my lunch and trying to scrape my food together, and in my mind I was scraping the food with my fork," Loanzan, a soft-spoken immigrant from the Philippines, told us in his home last November. But when he looked down into his lap, he realized, "I wasn't even holding my fork."

He had already been dropping things that week, and his wife was trying to convince him to go to the hospital. The day after the lunch incident, an MRI revealed that Loanzan had brain tumors. By then his hands were shaking uncontrollably.

Doctors scheduled surgery for later that week. But after two operations to remove malignant tissue the size of a grapefruit, the tumors grew back, leaving him numb and barely mobile. In January, after celebrating Christmas with his family, Loanzan stopped eating. On Jan. 21, two months after our interview, the tumors killed him, adding one more to the long and growing list of computer-industry workers dead from cancer at an early age.

There had been no warning of cancer risk from IBM, where he toiled in a poisonous and possibly carcinogenic stew for decades, Loanzan told us. The company's legally required material-safety data sheets warned of possible nausea and dizziness from the chemical-filled tubs over which he worked, Loanzan said,

"but they didn't say anything about tumors. They never talked about the place being dangerous."

Yet scientific studies and a potentially path-breaking lawsuit filed against IBM and its many chemical suppliers suggest that Loanzan's fatal disease may have been caused by his work. "His exposures led to the illness that caused his death," argues San Jose-based attorney Amanda Hawes, who is representing Loanzan's family and 10 other semiconductor workers in the lawsuit.

According to the February 1998 suit filed in Santa Clara County Superior Court, IBM maintained an internal "corporate mortality file," a database detailing the deaths of more than 25,000 IBM workers nationwide. Of 10,331 employees who died between 1975 and 1989, 149 died of primary brain cancer, the lawsuit states, citing a 1995 study sponsored in part by the company. That's 10 brain cancer deaths a year at IBM, a startlingly high number for such a rare disease.

The file now shows that 8,000 of the 25,000 deaths were due to some form of

IBM officials would not comment on the lawsuit, but spokesperson Michelle McIntyre told us, "Our clean rooms are extremely safe. We follow the strictest guidelines, and the care of our workers is the most important thing to us." In a written statement the corporation added, "We employ rigorous health and safety standards at all facilities, meeting or exceeding government standards in all cases. We constantly monitor and routinely survey the workplace environment for compliance to these standards."

Another plaintiff, who we'll call Alicia, asked that we not print her real name: she hasn't told many of her relatives, including her grandchildren, about her cancer. After logging 30 years in a dried-fruit cannery, Alicia, now 69, started washing hard-drive disks for IBM in 1977.

"We actually never knew what was in the washer; all we knew is it was some kind of soap with another chemical," said Alicia, who worked in every part of the clean room, including buffing, lube, testing, and coating. "You could smell the coating the minute you walked into the

resins and solvents." If chemicals splashed on my arms, they would go clear through to my skin," she said.

The company seemed to be aware that its workers were facing health risks. Alicia was regularly required to undergo highly secretive physical exams. "They would draw blood and take X rays," she said. "If you asked them about the results, they would say, 'If we find a problem, we will let your manager know.'"

After one such test IBM moved Alicia from the coating area for six weeks — but, she said, they never told her about any health problem. "Now I suspect that they suspected that something was wrong," she said. "If there was nothing wrong, why did I have to go through all these specialists? I don't think anybody ever saw their test results."

There were other cryptic exams. Every few months, Alicia said, "they would put a badge on you that would read how much radiation you were exposed to. When I asked what would happen if we received an overdose of radiation, they said, 'If you don't hear from us, you're

suffered spontaneous abortions.

As bad publicity mounted, the industry began sponsoring its own studies. It confirmed that there were serious reproductive health risks, particularly for spontaneous abortions, in clean rooms. One study funded by Digital Equipment Corporation found that fabrication workers in semiconductor facilities suffered spontaneous abortions at double the rate of nonfabrication staff. A subsequent 1992 UC Davis study funded by the Semiconductor Industry Association produced similar results and fingered ethylene-based glycol ethers as the culprit.

The industry began calling for a phase-out of glycol ethers, and over the past several years most major manufacturers have quit using the chemicals.

But a scientific review of the UC-industry study suggested that exposure to glycol ethers alone, separate from xylene and n-butyl acetate (also common in fabrication rooms), did little to increase spontaneous abortion risks. Meanwhile, researchers isolated other chemicals such as fluorine that raised spontaneous abortion rates. Likewise,

other solvents, such as acetone and isopropyl alcohol, "appeared to increase spontaneous abortion risk," researchers reported in a 1995 article for the *American Journal of Industrial Medicine*. In fact, glycol ethers were just one of seven chemical agents the research team linked to spontaneous abortions.

Nonetheless, the Semiconductor Industry Association used the earlier research to target glycol ethers as the primary cause of spontaneous abortions. It's a stance that exasperates Dr. Joseph

Ladou, chief of occupational and environmental medicine for UC San Francisco. Ladou has conducted extensive investigations of chip-plant toxins and health hazards and written numerous medical journal reports calling for greater scrutiny and tougher standards for the business. "The industry did a narrow study on just one issue: abortion," he told us. "They never proved that one chemical caused the problem, and they never went back to prove that the problem was corrected when they removed the chemical. The issue is much bigger than they would like you to believe."

Despite the hoopla surrounding the voluntary glycol ether phaseout — which the industry association has touted as a major success — there has been little follow-up to evaluate how many companies are still using the chemical, or how many women are losing their babies. "I don't know that anybody has done a post-survey to see what current use level is," said Dr. Jim Cone, director of the Occupational Health Branch of California's Department of Health Services. "That remains to be done."

The industry admits there has been little follow-through. "There have been no

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Cancer victim: Sherron Loanzan is pictured here with his wife, Cora, before his brain tumors — and after an operation that couldn't save his life.

cancer, Hawes said.

"Even though IBM knew that more and more IBM 'clean room' employees were being stricken with cancer as a result of exposure to toxic chemicals in clean rooms," the lawsuit states, "as a matter of company policy, IBM engaged in a concerted program of fraudulent denial, cover-up, concealment and corporate falsehood" designed to keep Loanzan and others ignorant of the life-threatening risks of their work.

'Clean room' dirt

Despite their name, clean rooms are awash in toxic solvents and acids that, even at low and legally permissible exposures, may be deadly when used for many years.

Loanzan's clean room career brought him in close, frequent contact with methylene chloride, Freon, kerosene, and acetone. In the grinding department Loanzan ground wafers to create a flat, even surface on which layers of circuitry could be placed. To ensure a smooth, clean cut, he used cutting fluids to cool down the machinery gears. One of the main ingredients in the cutting fluid, according to Hawes, has been linked in studies to brain cancer.

building. The smell was so bad you tasted it. Sometimes when you go into the plant in the morning, you feel light-headed when the fumes hit you."

One of Alicia's jobs was to place disks in coating and drying machines, a task that brought her into close contact with extremely noxious resins such as epoxy and solvents such as methyl isobutyl ketone, acetone, and xylene. The disk-drying machines, which run at 5,300 rpm, speeded mists filled with acetone and resins, she said. After a disk hurtled through the air and nearly struck a worker, IBM put up a Plexiglas safety shield. The shield, Alicia recalled, "would get covered with spray. We were breathing that."

She claims the company showed no concern for worker health. "We had protective clothes that covered your whole body, but that was not a protection for us, it was a protection for the product so that if we sneezed or coughed, we would not spit on the product," Alicia said. "We had a shower, and if we had a chemical spill on us, all we would do is strip and get under the shower." Chemicals soaked through the felt fire-retardant clothing she wore, sometimes leaving her street clothes underneath saturated with toxic

all right."

In November 1993, two years after she left IBM, Alicia was diagnosed as having breast cancer. There were no warning signs. After having undergone a mastectomy and chemotherapy treatment, Alicia has been in remission for six years, but she still suffers severe swelling and lumps, and her hands are numb from the surgery. Meanwhile, she said, IBM cut off her pension (the corporation reduced thousands of workers' pensions in 1999) and stopped paying most of her medical bills.

Alicia said coworkers have developed skin and breast cancers. Women have suffered miscarriages. One engineer she knows developed a muscular disability and can no longer walk.

Spinning studies

In the late 1980s, after studies showed increased spontaneous abortion rates among women drinking water contaminated by semiconductor facilities, investigators began looking at reproductive health problems among semiconductor workers. A 1988 study published in the *Journal of Occupational Medicine* revealed that up to 38 percent of pregnant women in high-exposure clean room processes

PHOTO COURTESY OF COVAD COMPANY

Silicon hell

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[follow-up] studies that I know of," Daven Oswalt, spokesperson for the Semiconductor Industry Association, told us.

Oswalt acknowledged that the semiconductor business is a "very high-intensity, chemical-laden industry because of the cleaning of the chips. There's no other way." But he said the business has been "very proactive" in reducing worker health risks, touting its occupational injury and illness rates as being some of the lowest among all manufacturing sectors. Clean rooms are "cleaner than hospital rooms," Oswalt said. "I'd rather live there than be on the street."

No time for safety

Evidence of semiconductor health and safety hazards is more subtle than the usual indicators, such as high injury rates and huge government penalties. The computer industry registers barely a blip on the federal Occupational Safety and Health Administration's radar screen. In 1999 federal and state health and safety agencies recorded just 148 violations totaling \$173,153 against companies manufacturing semiconductors, printed circuit boards, electronic computers, and peripheral equipment, OSHA records show.

The industry often cites such statistics in an effort to show that it has few workplace problems. But even OSHA officials say that's misleading; it's difficult for regulators to prove the connections between chemical exposure and worker illness.

"OSHA tends to be more active on the heavy-manufacturing side," said Dave Schmidt of the agency's office of statistics in Washington, D.C. "If you chop off a finger, we're there."

Less visible, yet equally worrisome, are occupational illnesses involving lost work time. While occupational illnesses represented just 14.3 percent of all manufacturing workers' ailments, they made up 30 percent of semiconductor employees' maladies, according to Ladou's analysis of 1997 government data.

His statistics show that semiconductor workers — who are largely Asian American and Latino and almost entirely nonunionized — are twice as likely as the average manufacturing worker to lose work time owing to occupational illness. Even more revealing, Ladou found that while just 2.6 percent of manufacturing workers' injuries and illnesses come from toxic exposures, the rate is 9.3 percent for semiconductor workers.

Even those figures may underestimate clean room health risks, Ladou told us, because they count semiconductor worker illnesses as a whole, while most of the health problems occur in the clean rooms. For instance, many semiconductor worker health studies use clean room workers as the test group and other employees as the control group, which is less likely to show symptoms.

One of California DHS worries most about semiconductor workers' "long-term exposures to carcinogens and cancer," he said. "There is still a question about labor statistics data showing a relatively higher percentage of reports of

acute illnesses."

Intense economic competition, rapid technological change, and corporate secrecy about proprietary chemical mixes all contribute to the health and safety barriers. In a 1992 essay titled "Semiconductor Manufacturing Hazards," Dr. Myron Harrison, a former IBM physician, noted that chip manufacturers had by the early 1990s compressed their product-development schedules from six to eight years down to two to three years, leaving little room for health and safety concerns. "The opportunities for these [health and safety] professionals to be involved before new processes arrive at the manufacturing floor are being diminished by the quickening pace of technologic change," he wrote.

The dead cancer study

The answer to the cancer question has been elusive and the search volatile. Despite epidemiology studies showing that more than 20 percent of all cancers are caused by workplace exposures, proving direct causal relationships between specific exposures and cancers is a "statistical nightmare," Ladou said. Still, anecdotal evidence, IBM's alleged internal corporate mortality file, and other computer-worker cancer clusters documented in medical journals suggest the industry may have a widespread cancer problem. But when activists and federal and state agencies were ready to launch a major study of semiconductor worker cancers early in 1998, the industry scuttled the project.

Under the EPA's Common Sense Initiative, the computer and electronics sector was among six industry groups meeting with government agencies and activists to discuss ways to simultaneously lessen industries' ecological impacts and environmental-law compliance costs. When the conversation turned to worker health, the industry — including representatives from IBM, Intel, and National Semiconductor — bristled. Janani Hironaka, executive director of the Santa Clara Committee for Occupational Safety and Health, who was active in the discussions, told us.

Hironaka's working group developed a preliminary study plan to measure cancer and birth defect rates among California semiconductor workers, using the state's cancer and birth-defect registries and then cross-referencing that with a semiconductor worker database to be created by the industry, Hironaka said. "We reached consensus that we would do this, and the EPA put \$100,000 on the table," she said. Meanwhile, California DHS agreed to provide the industry an "umbrella of confidentiality" to avoid identifying specific workers or companies.

But in January 1998 "the industry abruptly pulled out," Hironaka said.

Intel spokesperson Howard High contends that the study was flawed — and that it might have cost the industry more than it was willing to pay. "There wasn't a clear scientific approach, nor was there a structure on how it was to be funded," he told us.

But there may have been other reasons for the withdrawal. In a widely publicized remark replayed on the evening news, an Intel representative told the

group that "to participate in this project would be like giving discovery to plaintiffs. I might as well take a gun to my head and shoot myself."

Without industry cooperation, the study and its funding were put on indefinite hold, a serious setback to understanding and preventing cancer among chip workers. "We would know the cancer rates right now for 100,000 semiconductor workers in California if we hadn't been stonewalled," Ladou said.

One of California DHS is also frustrated, citing a "difficulty in both obtaining funding and getting cooperation with industry to actually do these studies" on cancers and acute illnesses in the semiconductor industry. "It's the biggest industry in the world, and it needs to be looked at. Every other major industry like this has cooperated [with extensive health investigations]," he noted. "So why is there this reluctance to cooperate?"

One said the cancer study also has "implications for plants in other parts of the world. We have a longer history with this industry here, and that information would be valuable not just for people here but around the world."

"There's no scientific evidence that suggests that fabrication workers have an elevated risk of cancers," industry spokesperson Oswalt responded. Despite the denials, in November 1999 the Semiconductor Industry Association announced plans to appoint an independent scientific advisory committee to review existing data about the industry. The committee intends to examine worker health data, injury and illness rates, and potential causes of cancer and, according to Oswalt, "then decide if further study is needed."

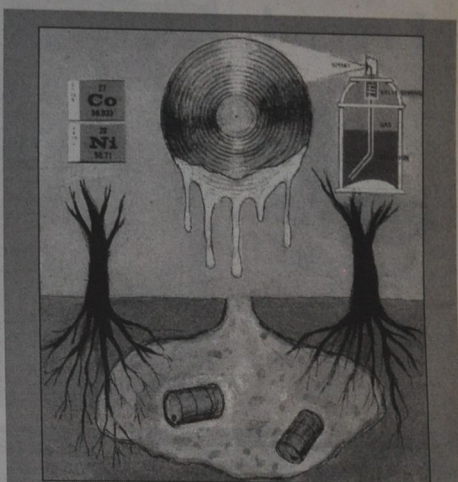
Burned alive

Recognizing the potentially explosive nature of e-component manufacturing, several Silicon Valley cities drafted stricter fire and hazardous chemical codes in the early 1980s. Municipal fire departments in the region now maintain special units to inspect businesses that keep large quantities of toxics on hand — and respond to accidents. A look at the records of the Sunnyvale, Santa Clara, and Mountain View fire departments found tech companies regularly breaking local laws — most fairly petty, but some serious.

Inspectors last year cited Hybrid Circuits' Sunnyvale plant for mishandling toxic detritus. Hybrid needed to "properly label the waste and dispose of it within the legal time frames. Also, provide records from the last two hazardous waste shipments," inspectors wrote March 9. In July 1999 the department also slapped electronics behemoth TRW Inc. for keeping four drums of toxic waste on-site longer than the 90 days allowed by law.

At Ion Implant Services' facility, which does early chip-preparation work, "approximately 30 gallons of flammable liquid waste was improperly stored" when Sunnyvale inspectors visited the semiconductor company in October of last year, according to a fire department report. "The material was in unlabeled one gallon bottles and was being stored on the floor without any secondary contain-

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Garbage in

Making a computer involves dozens of environmentally damaging chemicals

The manufacture of computers uses vast quantities of some of the harshest chemicals ever formulated. And an alarming amount of those chemicals ends up in the local water, ground, and air.

Of the 54 chemicals most used in the construction of chips, circuits, and monitors, 15 are known or suspected carcinogens; 14 are heavy metals, which are biological toxins. In 1997 (the most recent year for which data is available) the circuit and semiconductor industries nationwide landfilled, flushed, recycled, or released through a smokestack more than 117.5 million pounds of hazardous compounds.

And that's actually only a fraction of the total toxic releases. The figure is compiled from the Environmental Protection Agency's Toxic Release Inventory data, the agency's primary source for pollution statistics. But the EPA doesn't require operations that use less than 10,000 pounds of hazardous chemicals annually to report their toxic output — which typically excludes three-quarters of the businesses in any given industry. In 1997 only 406 chip and circuit factories nationwide filed TRI data with the EPA — and there are more than 800 chip and circuit plants in California alone.

To make matters worse, it's a scout's-honor type of program. The EPA relies on companies to come forward and truthfully document the amount of poison they spew in any given year; the agency doesn't monitor them or check their numbers for accuracy.

The vast majority of the toxic waste used to make computers winds up at some point being released into the environment. At least 30 percent of the toxics that go into making computers and other digital goods is sent to sewage plants, landfilled, or sent to the sky via smokestacks.

Toxics come into play at every major step of the process. We've analyzed three major components: chips, circuit boards and monitors.

The boards and chips

Printed circuit boards or printed wire boards are the metal-and-plastic foundation for almost all electronic hardware. These are the flat slabs of fiberglass or epoxy, typically green in color, that you'll find if you rip open a computer or just about any other digital device.

The typical manufacturing process, according to industry sources, starts with a copper-plastic sandwich, which is laminated and drilled with holes that will be used to mount components and provide pathways for electricity. It's dumped into a chemical tank and cleaned with solvents and acids. It's covered in copper and cleaned again with solvents and acids. Circuit patterns are stenciled on using photolithography, and it's cleaned with solvents again. The final circuits are laid out, and it's rinsed with water. The board is placed in a molten tin-lead solder bath, and excess solder is removed with hot oil or air. It's cleaned again, and then capacitors and other components are soldered onto the board before a final rinse.

Virtually all printed circuit boards are constructed by workers using compounds that can explode or burst into flame, as well as acids that can permanently blind.

The process of building semiconductors — the silicon chips, the Intel Pentiums, the heart of the computer — is similar. Nationwide, about 100,000 production line workers toil in some 1,000 chip plants. Semiconductor makers lay out a series of circuits on a waferlike surface and dip them into a series of solvent and acid baths. In the case of semiconductors, cleanliness, even at the microscopic level, is paramount. The chips are much, much

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news cover story

Silicon hell
from page 21

ment. Since the liquid is flammable it must be stored in a flammable liquid cabinet. Also, the material is hazardous wastes and was not labeled," the report reads.

Hybrid Circuits did not return *Bay Guardian* calls. TRW had no comment for this story. And Ion Implant recently went belly-up.

While many of the e-companies fail an inspection from time to time, a couple of manufacturers in the city of Santa Clara seem to have an especially hard time staying out of trouble.

Applied Materials — the world's largest manufacturer of semiconductor-making equipment — may rank number one in the valley for fire and safety code violations. Over the past seven years the company, based in an outwardly pristine, futuristic campus, has racked up at least 170 code violations. Fire inspectors cite recurring problems — some of them going back more than 10 years — like relying on extension cords in lieu of permanent wiring and having missing or badly placed fire extinguishers, improper sprinkler and fire alarm systems, and obstructed fire exits. This from a company that has up to 1,200 gallons of arsine gas — the superlethal gas form of arsenic — on hand at any one time.

Fire inspectors have demanded that the company "update [emergency] contingency plan. Current plan lists emergency coordinators who are no longer employed with Applied Materials," one admonition from a 1999 inspection states.

"Take steps to prevent future releases of hazardous wastes to the environment from any location at this site," ordered another, from a 1998 review.

The corporation has had problems with spilling verboten substances into storm drains. In one case, tubing to a pump failed and the plant sent 20 to 30 gallons of sodium hydroxide into the sewers. "Sodium hydroxide is like lye," said Doug Hansen, a hazardous materials specialist with the Santa Clara County Fire Department. "It's pretty caustic stuff."

Hansen, however, downplayed the volume of violations, chalking them up to the size of the operation, which is spread across five campuses and larger than most of the plants he checks up on. "We have noticed [the violations], and we are currently working with the company to come up with a compliance plan. The company is cooperative and meeting with us regularly," he said.

Safety is Applied Materials' number one priority, according to spokesperson Jeff Lettes. "We're working with the city of Santa Clara to make sure we have a world-class system in all respects," he told us.

Last year chip maker LG Epitaxy folded, but not before getting very well acquainted with the Santa Clara fire department. In 1993 the city ordered the company to hire an "approved independent safety consultant" as a result of "a toxic gas alarm and the inappropriate response by your employees," according to letters sent by the department to the corporation. Between 1995 and 1999 the department responded to three dozen emergency calls from the plant — several for

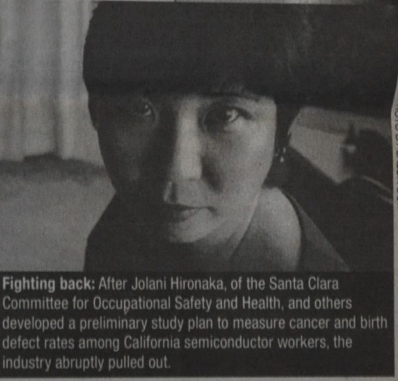
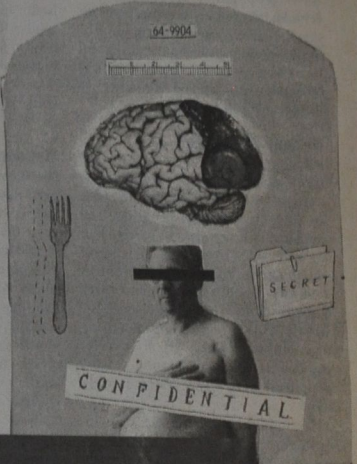
accidental gas releases — and cited the company 96 times for code violations.

On April 26, 1997, answering a 911 call, the department's hazardous materials unit showed up to find 30-year-old Jeffrey Saurman in critical condition. In an accident that seems similar to the recent blunder at MMC Technologies, Saurman had inadvertently mixed alcohol with nitric and hydrofluoric acids while working over a chemical bath. The combustible mixture exploded, creating a caustic red-yellow cloud and burning his arms, legs, and face.

According to investigators with the state OSHA, coworkers in another part of the building noticed something was wrong when the acid scent wafted their way. Coming upon Saurman frantically rinsing his charred body in an emergency shower, they dragged him outside, away from the fumes, and rang for an ambulance. The man died of multi-organ failure two weeks later. He hadn't been

cisco Bay as "impaired" due to excessive amounts of copper and nickel. The federal government fingered local industry as partially responsible for the pollution.

"Copper is a biocide," Mike Lozeau of Baykeeper, an environmental group devoted to protecting the local watershed, told us. "It's very bad for the bay. A lot of aquatic animals are sensitive to copper at low levels." Specifically, copper and nick-



Fighting back: After Jolani Hironaka, of the Santa Clara Committee for Occupational Safety and Health, and others developed a preliminary study plan to measure cancer and birth defect rates among California semiconductor workers, the industry abruptly pulled out.

wearing protective clothing.

The state slapped LG Epitaxy with seven charges, notably failing to develop safety guidelines for employees and failing to properly label chemical containers, but fined the corporation just \$1,000. Fire department investigators said the death was largely Saurman's fault, but it blamed the company for a "lackadaisical approach to training and fire safety."

Death in the bay

The tech industry's toxic problems don't stay on the factory floor. The biggest spewers of heavy metals into the bay have long been the South Bay circuit companies. A 1988 study by Citizens for a Better Environment (now Communities for a Better Environment) found that 9 of the top 12 dumpers of toxic heavy metals into the local environment were tech companies. Two years later, bowing to pressure from greens, the EPA officially listed the southern end of the San Fran-

co kill phytoplankton, a microscopic plant that constitutes a crucial part of the marine food chain.

In recent years local authorities have lowered the amount of metal the factories can discharge, and most electronics plants have tempered their water-polluting tendencies. But a *Bay Guardian* review of San Jose's sewage-treatment records — going back to 1995 — found a few tech firms regularly violating local and federal clean-water laws. In addition to metals, the effluents coming from these factories include an unhealthy dose of volatile chemicals.

Simply put, the manufacturers are sending toxic effluent to the public sewer system, which attempts to treat it, but a significant amount still ends up in the bay with the discharged wastewater.

Our findings include the following:

- In 36 inspections, Spectra Diode Labs Inc., which builds lasers for com-

puter systems, failed seven times. The company has a problem with discharging illegally high levels of arsenic. Last year the company was twice caught dumping arsenic at double the legal limit, one time it clocked in at three times the limit. (SDL officials declined to comment for this story.)

• Santa Clara's Pyramid Circuits bombed 8 of 49 inspections, emitting illegally large amounts of cyanide, copper, lead, and ethylbenzene and toluene. (Pyramid officials declined to comment for this story.)

• Sun Circuits' Plant Number One in Santa Clara racked up 13 violations for releases of copper and lead. On at least three days in 1998 and 1999 Sun Circuits discharged water tainted with triple the legal limit for copper; in 1995 the company violated lead limits twice. Sun Circuits president Mark Shebby told us the company has had only one violation since 1998.

• Kion Technology, in San Jose, was inspected 29 times and flunked on 12 occasions. In 1998 and 1999 the company flushed high doses of chloroform with its water, dumping more than six times the legal limit in one instance. Kion also spewed illegal levels of methylene chloride, silver, chromium, nickel, and lead. (Kion has since gone under.)

• San Jose's Data Circuit Systems had similar problems, piling up 17 violations for toluene, copper, chloroform, and lead. "The sample was black in color," one inspector's field notes read. (Data Circuit Systems would not comment for this story.)

The Superfund capital

At the busy intersection of El Camino Real and Page Mill Road in Palo Alto lies what looks like an utterly average vacant lot, a grassy, weedy tract with a few trees scattered about. But closer inspection reveals another — not so normal — features.

Yellow-painted pipes in clusters of four jut up through the grass. Embedded in the earth throughout the 10-acre site are circular steel disks bearing the words "monitoring well." And behind a 10-foot-tall wooden fence lies a strange industrial contraption equipped with dozens of pipes, lights, switches, and a rusting metal smokestack.

The land is owned by Hewlett-Packard, and it's an EPA National Priorities List — or Superfund — site, meaning it ranks as one of the most polluted pieces of land in America. Actually, it's not the earth here that's poisoned; at the direction of the feds, the company removed 910 cubic yards of contaminated soil from the lot and shipped it to a hazardous waste dump. The major problem is the groundwater, it's laden with solvents dichloroethane, trichloroethane, and trichloroethylene. In 1995 the regional water board estimated the contaminated plume at 2,000 feet long and 80 feet deep.

The yellow pipes mark subterranean pumping stations where tainted water is squeezed from the earth. The monitoring wells are in place to keep tabs on aquatic toxicity. The smokestack and attendant machinery filter the contaminated water, pushing the pollutants out the top end of the stack and forcing the purified water

back into the shallow aquifer from whence it came. In industrial disaster parlance it's called a "pump and treat" operation.

From the 1960s to the mid 1980s a Hewlett-Packard plant on the lot cranked out electronic equipment. In 1981 the tech giant discovered that a seeping underground solvent tank had spilled at least

300 gallons of chemicals into the soil.

Hewlett-Packard says its environmental mistakes are just a bad memory. "This site is from the early eighties — if you look amongst the major companies, we were using the best [storage tank] technology available at that time," said Dean Elsie, a spokesperson for the company. "It turned

out that technology didn't safeguard the environment long-term. As soon as we found out there were some issues with the Page Mill road site, we voluntarily excavated the tank and began [decontaminating the lot]."

Today, Elsie said, the electronics giant is striving to make its manufacturing

processes more eco-friendly. "The processes that were used at that time have been radically changed to ensure the processes become more environmentally safe," he said. "We've eliminated our use of tons of chemicals." His comments are borne out by EPA stats.

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Garbage

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smaller than circuit boards and much, much more valuable.

Monitors and displays

The standard computer monitor — essentially a TV — is referred to in the industry as a cathode-ray tube. The biggest environmental problem with monitors is lead; each one contains up to five pounds of the stuff, mostly in the glass at the front of the monitor. The lead is used to shield the user from the electrons being shot at his or her face from the back of the monitor. Lead has long been shown to cause brain damage. Building monitors also relies heavily on solvents.

Laptop computers, PalmPilot-type devices, pagers, and cell phones all come equipped with what are known in the industry as "flat-panel display" screens.

Flat-panel displays, which are made in several ways, come equipped with their own set of environmental problems.

Below are the 10 most-used chemicals in chip, circuit board, and monitor manufacturing, as documented by 1995 EPA data (the most recent available). Descriptions of their toxic effects are derived from the National Library of Medicine's Hazardous Substances Data Bank.

• **Nitric acid and nitrate compounds** Nitric acid is lethal. It kills flesh almost instantly. Get it on your finger and your finger burns off. Inhale a bunch of it and your breathing stops forever. Contact with the eyes can cause permanent blindness. The National Institute for Occupational Safety and Health recommends that employees who work with nitric acid undergo annual chest X-rays and lung-function tests to check for chemical-induced breathing ailments, as well as "a visual examination of the teeth for evidence of dental erosion." Other nitrate compounds taint water.

Amount discarded or released directly into the environment by the computer industry each year: 6,036,886 pounds

• **Ammonia** Inhalation of ammonia vapors typically starts making people sick at 20 parts per million. Long-term exposure can cause bronchial disease. Acute exposure can kill. Direct contact causes burns.

Annual amount discarded and released: 2,021,490 pounds.

• **Certain glycol ethers** Several studies show a miscarriage connection. In the mid 1990s the industry said it was phasing these compounds out, but our research shows some tech manufacturers are still using them. High levels damage the nervous system, liver, and kidneys. Moderate glycol ether poisoning results in nausea, vomiting, headache, diarrhea, abdominal pain, and damage to the pulmonary and cardiovascular systems. One ingredient found in glycol ethers was also used in a drug approved to treat bacterial infection. That drug caused more than 100 deaths due to acute kidney failure and was pulled from the market.

Amount discarded and released: 1,121,048 pounds (this number is likely to have decreased since 1995, as a result of phaseout efforts).

• **Copper and copper compounds** Not particularly poisonous on its own, copper can kill when combined with other chemicals. For example, copper sulfate, which is heavily used by the industry, is an explosive acid. It is often mixed with lead and nickel.

Amount discarded and released every year: 904,433 pounds.

• **Methanol** Toxic to humans in moderate to high doses, according to the EPA, methanol causes central nervous system impairment. Lab tests on animals show liver and circulatory damage.

Amount discarded and released every year: 642,082 pounds.

• **N-methyl-2-pyrrolidone** Exposure to semiconductor workers at levels as low as .7 parts per million can cause headaches and chronic eye irritation, according to medical journals. Prolonged contact can cause severe dermatitis.

Amount discarded and released every year: 1,156,974 pounds.

• **Xylene** It can cause birth defects including hydranencephaly (sacs of fluid where the brain should be) in babies born to mothers exposed to xylene on the job. It's also linked to deformities of the lower spine, stomach, and legs, not to mention miscarriages and hemorrhaging during childbirth. Even relatively mild exposure can mess up the central nervous system, inducing nausea, headaches, loss of muscular coordination, and chronic bronchitis. Higher doses can cause permanent coma.

Amount discarded and released every year: 459,701 pounds.

• **Hydrochloric acid** It causes cancer in lab animals. Direct contact with a sizable amount is disastrous: Flesh melts. The body goes into shock and turns clammy, as circulation collapses. The airways contract. If the acid gets down the esophagus and into the guts, they rupture. A relatively minor burn on the face may cause the teeth to become soft, dull, and finally break off. The World Health Organization puts the upper limit for safe exposure at 30 parts per million. "Even this might be harmful if daily exposures were continued over periods longer than one month," according to the group. Chronic exposure is linked to chronic skin, eye, respiratory, and dental disease.

Amount discarded and released every year: 902,039 pounds.

• **Lead compounds** Probable human carcinogens, lead compounds are world-class brain wreckers. Chronic exposure may also cause blood, nervous system, kidney, and gastrointestinal damage.

Amount discarded or released every year: 1,205,486 pounds.

• **Chlorine** It's found on the EPA's "extremely hazardous substance," "hazardous air pollutant," and clean water threat lists. Inhaling minuscule amounts can impair the lungs, while exposure to only 50 parts per million is dangerous even for short periods.

Amount discarded and released every year: 6,965 pounds.

Silicon hell

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Hewlett-Packard wasn't the only company to find itself spewing solvents. During the early '80s dozens of Silicon Valley e-manufacturers discovered they had leaking chemical tanks. The roll call included IBM, Intel, National Semiconductor, Advanced Micro Devices, Fairchild Semiconductor, Applied Materials, and numerous others. Eventually 29 industrial contamination areas would be added to the National Priorities List. Digital-hardware plants were directly responsible for 21 of them, while 4 more were created by businesses serving the industry. Intel and Advanced Micro dived in with three Superfund sites each; Fairchild and Hewlett-Packard managed to create two sites.

The contamination level was — and is — massive, making Santa Clara County home to more National Priorities List tracts than any other county in the country.

In many cases the chemicals dripped into shallow groundwater pools and began spreading toward drinking-water sources deeper down. IBM managed to give birth to an underground chemical ocean that spread at a rate of 5 to 30 feet a day and eventually covered an area three miles across and 180 feet deep. Intel started one toxic plume that mingled with other nearby contamination sites to reach 6,000 feet in length and 500 feet in depth. Water samples taken from the sites have hit up to 4,000 times the safe levels for cancer-causing and mutation-inducing chemicals. Thousands of gallons of drinking water have been poisoned or permanently lost.

At most sites cleanup is expected to continue for years or decades. Environmentalists say 100,000 people may have been exposed to hazardous chemicals.

"I actually think that one of the most important things the EPA did in this valley is list those sites," said Ted Smith, a founder of the Silicon Valley Toxics Coalition. "It punctured the myth of the clean industry. It sent a very strong message around the world that this was a very toxic industry. It sent a message to the corporations that pollution doesn't pay. Some of the people in the boardroom have gotten the message that pollution prevention is cheaper than pollution cleanup."

But the problem according to Smith — and EPA stats that show an overall increase in chemical use by the electronics business — is nowhere near being solved. "What's happened is, there's been some progress made with individual plants [and classes of chemicals], but the growth of the industry is so fast and so strong that overall pollution is growing. If you get [toxic release] numbers for the rest of the world — which you can't because most countries don't keep them — you'd see pollution increasing massively."

In Silicon Valley you're rarely more than a few miles from a contamination cluster. Pull off Highway 101 at the Bowers Avenue exit and head into the city of Santa Clara. Go west into the heart of the town's digzone. Within three blocks you've passed USWest, Advanced Micro, Applied Mate-

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Silicon hell

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rials, and Intel. You've also passed five polluted tracts the state is remediating — including the oh-so-picturesque former home of Magnetics Peripherals, now a fenced-off dirt lot with Freon-laden groundwater — and Intel's Superfund site. Drive a few more blocks and you've gone past two more areas rated "worst of the worst" by the EPA.

To the tech firms' credit, the EPA says the industry has worked hard to handle the mess it has created, and in the past few years some of the tech-caused Superfund sites have been removed from the Superfund file thanks to thorough cleanup efforts paid for by the companies.

But across the EPA's Region Nine — covering California, Arizona, Nevada, Hawaii, and America's Pacific colonies — are scattered 119 active National Priorities List sites, and e-businesses are to thank for 21 of them, more than one-sixth. Then there are the eight active partially tech-caused sites, like the south San Jose lot where Lorenz Barrel and Drum once operated. For 40 years the company got rid of hazardous detritus for businesses of all sorts, including electronic component makers. Proprietor Ernest Lorenz's disposal technique of choice consisted of burying the lethal compounds on his 5.5 acres of land — surrounded by San Jose State University, working-class homes, and a children's petting zoo.

In 1986 federal authorities shut the business down, slapped Lorenz with criminal charges, and began seeking damages from the companies that had sent their refuse to Lorenz. A decade later the EPA billed 11 "responsible parties" — including IBM and Romtec, a company specializing in solvent removal for the computer industry — \$5.2 million to clean up the plot. Today the entire tract has been covered with an asphalt cap, and cleanup is ongoing, with water being pumped out of the soil and heavily treated. "Nothing will ever grow there again," the EPA manager for the site said.

While the federal government, local agencies, and hundreds of thousands of Bay Area residents and company workers are dealing with the computer industry's mess here in America, the same (or worse) problems are spreading worldwide. As jobs on the digital assembly line become ubiquitous in the developing world and the entire globe gets wired, the same companies that despoiled the valley are busy opening plants in such countries as Mexico, Costa Rica, Malaysia, Taiwan, and India — countries not renowned for strong labor or environmental laws.

Millions of computers churned out worldwide equals millions of pounds of poisons. "We're undergoing the largest, fastest industrial expansion in history," Smith said. "What happens here [in Silicon Valley] can be a bellwether for the rest of the world — where companies learn from their errors before they go overseas. Too often we're seeing the other — where the problems get exported." ♦

Lucia Hwang, Randall Lyman, Stephen Bender, and the DataCenter conducted additional research for this story.