

The  
Dark  
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**THE  
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*HARPER & ROW  
1985*

BY  
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Chapter  
Eight  
**THE  
TOXIC  
TIME  
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**E**arly in 1984, a producer of printed circuit boards for computer and other high-tech manufacturers announced that it was closing its Mountain View plant, in the heart of Silicon Valley, because it could not comply with local ordinances regulating the storage and disposal of hazardous materials. CTS Printex, which employed more than four hundred people, said that it was moving across the San Francisco Bay to Fremont, on the eastern edge of the Valley's ever-expanding electronics complex.

The announcement provoked a protest, but not in Mountain View. No one there questioned the need to enforce the community's increasingly strict environmental ordinances. In Fremont, however, neighbors of

the proposed plant joined with a local group called Sensible Citizens Reacting Against Hazardous Materials to tell city planners flatly that they did not want a firm with a dirty track record operating in their neighborhood.

Fremont and Mountain View residents, along with anybody else who reads a newspaper or watches TV news in Silicon Valley, are all too familiar with what still ranks nationally as one of high-tech industry's greatest secrets: Electronics is a dirty industry. It is possible that communities and regions which study the lessons of Silicon Valley can substantially reduce the risk high-tech production poses to the environment and public health.

Unfortunately, high tech's environmental record has not leaked out to the rest of the country. Officials who promote high tech as a solution to local or regional economic ills paint a picture of the industry as shiny as the surface of a silicon wafer. They call high tech a "sunrise industry," clean and light in contrast to "smokestack" industries like steel and auto production, known for their drab, monstrous factories and ever present plumes of vapor and smoke. In June 1983, for instance, Texas Governor Mark White, having lured a major new high-tech venture into his state, told reporters: "I don't think you'll find that there will be any pollution [from the electronics industry] unless the Japanese cars they drive to and from work do it."

It isn't hard to see where high tech got its reputation. Electronic products—chips, computers, switchboards, and so on—don't breathe exhaust or drip oil. The factories are rambling, well-landscaped buildings, resembling modern college libraries; no smokestacks protrude above their facades. Many production steps take place in so-called clean rooms, where the air is fanatically filtered and production workers wear surgical gowns. But the industry's vast investment in cleanliness is de-

signed principally to protect microelectronic components from the dust particles that could prevent them from functioning properly. It does not protect high-tech's workers, nor the residents who live in the communities that surround the plants, from the toxic chemicals and metals essential to high-tech manufacturing.

One of the greatest ironies of microelectronics technology is that the transformation of America into an information society relies, at its core, upon a technology from the industrial era: chemical processing. The manufacture of chips, printed circuit boards, magnetic media, and other high-tech products uses some of the most dangerous materials known to humanity. And the accidental release of those toxins into the air, the ground, and bodies of water poses a significant threat to public health.

High-tech pollution is a fact of life wherever the industry has operated for any length of time, from Malaysia to Massachusetts. Yet nowhere has the growing threat that electronics production poses to public health been clearer than in Silicon Valley, where the concentration of high-tech production has greatly magnified the industry's environmental problems.

The hazards of high tech have become increasingly clear during the past few years, but it may be decades before the full impact on public health is known. The electronics industry uses thousands of different toxic materials, yet the volume is small compared to chemical-intensive industries such as petroleum and pesticide production. Still, a Bhopal-like incident, in which hundreds of people are killed immediately from a single leak, is a serious possibility.

Even without such a catastrophic accident, however, the long-term toll from high-tech pollution may be enormous. High-tech toxics have been slowly entering the environment of Silicon Valley for decades. Though

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widely used chemicals such as hydrocarbon solvents are known to cause ailments ranging from headaches and birth defects to cancer, it is difficult to demonstrate that any particular person is a victim of a particular leak or spill. But there is no doubt that industrial chemicals are affecting the health of growing numbers of people.

- San Jose attorney Amanda Hawes is one of a handful of Silicon Valley activists who warned for years that high tech was indeed a hazardous industry. She has built up her reputation by representing electronics workers injured by chemicals on the job. Today she also represents residents of the Los Paseos neighborhood in southern San Jose. A new, comfortable, working-class suburb typical of Silicon Valley, Los Paseos is distinguished by the presence of a chip manufacturing factory built by Fairchild Semiconductor in 1975.

Hawes carries with her a large zoning map of the area surrounding the Fairchild plant. On every block in the surrounding neighborhood there are several colored pins and flags. Each triangular red flag represents a child born with heart anomalies; each blue pin marks a miscarriage; each yellow flag signals a cancer case. Black flags, superimposed on the other markers, note recent deaths. Hawes also carries with her a supply of pins, and she must frequently add one to the display. She charges that Fairchild is responsible for the area's high incidence of disease.

Most of Hawes's clients believed that electronics was a pollution-free industry until January 1982. At that time, officials disclosed that six weeks earlier they had shut down a drinking water well operated by the Great Oaks Water Company, just 2,000 feet from an underground chemical storage tank at Fairchild. Solvents from the tank, including suspected carcinogens tri-

chloroethane and dichloroethylene, had entered the water supply. When residents learned of the leak, they quickly concluded that the company was to blame for the area's alarmingly high incidence of birth defects and miscarriages.

Since then, Fairchild has spent at least \$15 million to reduce the concentration of solvents in the aquifer, but the water will never be as clean as it was before Fairchild set up shop there. Now the factory stands empty, a monument to the dying myth of high tech as a clean, light industry.

The Fairchild leak exploded onto the local front pages and six o'clock news, breaking through a long-standing barrier of silence on high-tech pollution. The Bay Area press, public officials, and electronics corporations themselves have all been forced to investigate environmental hazards that nobody wanted to believe existed.

Today, scarcely a week passes without the revelation of a new leaking storage tank, poisoned well, or pollution law violation. As soon as the extent of the Fairchild leak was known, other companies started to test the ground water around their underground chemical tanks, and the Bay Area's Regional Water Quality Control Board ordered a comprehensive testing program. Most of the Valley's large production sites were checked—and most came up dirty. Even firms with a reputation for environmental concern, like Hewlett-Packard, had been leaking dangerous toxics used in their manufacturing processes.

Leaks were found at scores of industrial locations within Santa Clara County, but many small facilities have still not been tested. Nineteen high-tech sites have been placed on the Environmental Protection Agency's "Superfund" list. Nine public and more than sixty private wells have been shut down; many others contain legally allowed levels of contamination. Luckily, Silicon

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Valley residents have thus far been spared an outright environmental disaster. The Valley's largest source of drinking water is protected by a 200-foot layer of clay, which separates polluted ground water from deep aquifers.

Though Fairchild and nearby IBM began the task of clean-up soon after pollution from their facilities was discovered, many Valley electronics firms have not done much more than sink test wells to determine the extent of their leaks. Pools of hazardous chemicals drift around underground, poisoning shallow private wells and possibly finding a route—for example, via an abandoned agricultural well—to the public water supply. Unless the toxic chemicals are removed or neutralized before they percolate through the clay, the primary water supply of several hundred thousand people will be permanently poisoned. Silicon Valley is sitting on a toxic time bomb. No one knows when it is set to go off; certainly, not enough is being done to defuse it.

Despite the slow clean-up rate, Silicon Valley's governmental agencies and high-tech companies acted quickly to develop rules and storage procedures for preventing future leaks. Their approach, the core of which now is built into both federal and California state law, is serving as a model for the regulation of hazardous materials, including gasoline as well as high-tech toxics, across the nation.

Soon after the Fairchild disclosure, fire chiefs representing Santa Clara County's individual cities and fire districts established a task force to develop tighter local regulations governing the handling and storage of hazardous industrial materials. The task force was asked to develop a model ordinance for passage by each industrial city in the county plus the county government, which governs unincorporated areas. The fire chiefs chose not to look at occupational health and safety is-

issues, which are currently regulated by federal and state agencies; they focused instead solely on chemical leaks and potential fire hazards. They sought to close a major gap in existing regulations by establishing standards for the storage of nonflammable, "virgin"—that is, awaiting use—industrial toxins.

Almost immediately, trade associations representing the Valley's high-tech companies asked to participate in the task force. Welcomed by the chiefs, they sent engineers, not PR flacks. Rather than oppose the ordinance outright, the engineers sought to shape a regulatory program with which they could live. Industry representatives agreed to a requirement that they install double-walled containers for all new underground toxin storage. The principle is both simple and sound: If an inner tank leaks, the secondary barrier will contain the chemical or waste. This simple standard should prevent most future leaks from entering the environment.

In return, the fire chiefs accepted industry's argument that it would be impractical to replace all existing tanks, some of which were built under the factory floors. Under the proposal, old single-walled tanks could remain in use as long as a rigorous monitoring program, also required by the ordinance, detected no leaks.

A few months after it began its work, the task force held its first public hearing. Men in business suits packed the Sunnyvale city council chambers to hear initial reports from the group's committees. Though open to the public, the hearing had not been advertised. The dialogue, it appeared, was planned solely between city officials and high tech.

Community, labor, and environmental groups learned of the meeting through the newsletter of an industry association, and a handful of representatives from public-interest groups testified. Soon they formed the Toxics Coalition, which then injected itself into the deliber-

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ations, forcing the adoption of strong public disclosure and "whistleblower" protection sections. Despite the lack of union representation in the electronics industry, organized labor mobilized the activists—from firefighters', construction, aerospace, and other unions—that gave the Coalition its clout.

Though there was never any doubt that Silicon Valley's environmentally sensitive communities would enact ordinances to regulate toxic storage, high-tech industry's official leadership took the unusual step of lobbying for strong, uniform regulation. In the city of Mountain View, for instance, a public hearing began as a caricature of the national conflict between environmentalists and business. A small gas station owner decried unnecessary government intervention, while a spokesman from GTE Sylvania asked the city to enact weaker rules than those proposed by the fire chiefs' task force. Members of the Toxics Coalition urged strong regulation.

Then a member of the audience rose to back the environmentalist position emphatically. There was nothing original about his presentation, but his position was unique. Larry Borgman, manager of plant facilities at Intel, speaking as the official representative of Silicon Valley's four major trade associations, offered industry's unequivocal support for the legislation. GTE's executives never spoke out against the measure again.

The model ordinance, written to apply to the underground storage of all toxic chemicals, drew opposition from the petroleum industry. At first service station owners and major oil companies objected to the proposal; then they argued for exemption. Finally, they tried to weaken the standards. Unlike the electronics industry, "big oil" sent its PR men to discuss the problem.

Electronics executives suggested that all industries

should be treated equally, and the Toxics Coalition reminded officials of the numerous underground petroleum leaks discovered in the area. After all, commercial gasoline contains 2 to 4 percent benzene, a recognized carcinogen, as well as lead and other toxins. In the end, the Santa Clara County Inter-Governmental Council, representing the cities, county, and other public agencies, recommended a strong model ordinance; most of the county's cities enacted its provisions and budgeted funds for its enforcement.

Since then, both the state of California and the federal government have enacted legislation imposing double containment standards similar to those developed in Silicon Valley. California has already registered over 114,000 existing underground chemical storage tanks.

So, some progress has been made. Without enforcement and citizen awareness, however, laws on the books will have no effect on the potential toxic time bomb that high-technology manufacturing represents. It will take public pressure, over several years, to force the state and the Environmental Protection Agency to fund adequate levels of enforcement.

- In the wake of the Fairchild tragedy, leaks from underground storage tanks have received the greatest public attention in the Valley; but sewage from high-tech plants also threatens the environment. Despite federal and state regulation, concentrations of toxic heavy metals such as nickel, lead, and cadmium are building up in the San Francisco Bay, entering the food chain through the Bay's surviving fish population.

The manufacture of semiconductors and printed circuit boards creates large quantities of liquid waste. Producers are required to pretreat their toxic waste, precipitating it into a sludge for disposal at approved

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landfills. Sewage treatment districts, worried that toxic effluent could damage the organisms that process the sewage at their treatment plants, closely monitor industrial effluent for its heavy metal and toxic chemical content.

In 1983, Citizens for a Better Environment (CBE), a San Francisco-based watchdog group, reviewed the records of sewage treatment agencies and found widespread violation of pretreatment standards throughout the Bay Area, including Silicon Valley. Those records, of course, did not list the scores, perhaps hundreds of small electronics firms that routinely pour hazardous materials directly down the drain. To compound this, the problem may grow more severe. As the cost of proper treatment rises, the temptation to dump industrial chemicals illegally rises.

In response to the CBE study, regulators are now cracking down on at least some of the violators. In February 1984, for instance, operators of the San Jose sewage plant, which serves Santa Clara, San Jose, and several smaller communities, threatened to revoke the discharge privileges of five printed circuit firms. In July 1984, the Environmental Protection Agency ordered thirty-two Valley firms to pretreat their effluent properly or face fines of up to \$10,000 per day.

Inspectors say that most of the Valley's large manufacturers and many small ones comply with existing pretreatment standards. Such rules, however, may not be enough to protect the Bay, which is slowly being poisoned by high-tech sewage. As Mike Belliveau of CBE warns: "Those standards originally were drafted more than ten years ago and were based on deep ocean discharge, not for a dead-end slough at the south end of the Bay where the water is only six feet deep."

The development of new industrial processes that will generate less waste is necessary if the growing

environmental load of high tech is to be contained. Pretreatment is reaching its limits, since materials discharged in extremely small amounts can rise to high concentrations in the treatment process. The presence of gold in Silicon Valley sewage, while not considered an environmental hazard, illustrates the problem. Many electronics firms use gold to build their products, and no manufacturer, large or small, is going to be lax in the discharge of gold into sewage lines. Yet the Palo Alto sewage plant sells its sludge to a firm that burns the sludge and "mines" the ash for gold!

- The sludge generated in sewage pretreatment, as well as other bulk chemicals and hazardous solid wastes, also pose a serious environmental hazard. Since approved Class I dumpsites—those specifically designed to handle hazardous wastes—are located far from the communities which offer a quality of life attractive to high-tech firms and professionals, tons of hazardous materials are trucked along the highways every day. Accidents are inevitable.

In late 1981, for instance, a tank truck carrying wastes from a Silicon Valley electronics firm pulled over at a roadblock in San Ramon, on the eastern side of the San Francisco Bay. Inspectors were looking for embargoed fruit, but instead they found a potential chemical disaster. The truck was leaking. Four thousand nearby residents and schoolchildren were quickly evacuated, yet at least twenty-two people had to be treated at local hospitals for respiratory complaints. The truck had been transporting copper, zinc, chromium, and titanium wastes, as well as sulfuric, nitric, hydrochloric, and acetic acids, to a Class I hazardous waste site.

Nobody knows how much illegal high-technology waste dumping actually occurs. In June 1983, officials in

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Southern California found nearly eighty 55-gallon drums of hazardous chemicals in a stolen trailer in a parking lot in the remote community of Castaic. Investigators traced the wastes to Silicon Valley's Electrofusion, which had hired the Silicon Valley Hazardous Waste Transportation Company to haul away its hazardous wastes.

Electronics companies are not held responsible for the actions of contractors that are licensed to haul hazardous materials, but they are generating new forms of hazards faster than the waste handlers can update their methods. There are state and federal regulations to govern the waste transportation and disposal industry, but the enforcement agencies are hampered by being both underfunded and understaffed.

Furthermore, even when they are handled in accordance with the latest technologies and regulations, hazardous wastes represent another toxic time bomb. Many chemicals generated by the electronics industry, such as the hydroxides formed in sewage pretreatment, are likely to outlast the dumpsites at which they are "disposed." In October 1984, the Environmental Protection Agency fined the operator of the two dumpsites closest to Silicon Valley \$161,000 for leaks.

In June 1985 it sought \$7.4 million in penalties from another disposal firm, while six environmental groups charged that all dumps receiving Silicon Valley's hazardous wastes were leaking.

Even if disposal companies meet EPA standards, they are holding materials which, like nuclear waste, retain their toxicity almost indefinitely. Disposal in geologically suitable sites may be safe in the short run, but future generations will have to face the consequences of dangerous leaks unless better disposal or reprocessing techniques can be developed.

Both the state and federal governments are slowly enacting regulations restricting the disposal of particularly dangerous classes of toxic wastes; however, the rules contain loopholes allowing for land disposal until viable alternatives are found. As long as the loopholes are there, it is unlikely that either the electronics industry or the petrochemical industry will develop and test large-scale alternatives.

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- If any one visual characteristic has distinguished high-tech factories from the behemoths of heavy industry, it has been the absence of smokestacks. In Silicon Valley, municipal architectural standards require that manufacturers hide their vent outlets behind fancy façades. Nevertheless, high-tech plants spew tons of smog-producing fumes and toxic gases into the air every day. More dangerous still, a minor industrial accident, such as the rupture of a single cylinder of a commonly used gas like arsine or phosphine, could hospitalize or even kill scores or even hundreds of local residents.

For an industry that is reputed to be "clean and light," the scale of pollution is phenomenal. The Bay Area Air Quality Management District estimates that semiconductor firms alone in Silicon Valley emit 10 tons per day of "ozone precursors"—hydrocarbon solvent vapors which are chemically transformed into smog. Eight corporations are reportedly responsible for 74 percent of that total. In June 1983, the District enacted new controls on atmospheric emissions from semiconductor plants, designed to reduce vapors by a total of at least 3 tons per day.

High-tech executives treated the proposed air-quality standards in much the same way as they handled the storage ordinance. They did not oppose the regulations

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outright. Instead, they worked closely with the District staff to win technical modifications and delays that would ease the cost of compliance.

Much to the chagrin of the Toxics Coalition, however, the Air Quality District has delayed consideration of rules governing "exotic" emissions. These are chemicals, including potentially lethal gases such as arsine and phosphine, which are vented in small quantities by high-tech firms. In low concentrations, toxic gases might affect the health of only one in ten thousand, or one in a hundred thousand people. When several hundred thousand people are exposed over a period of time, however, the danger is real. Assessing the risk is a complex matter, so the District is waiting for California's statewide Air Resources Board to measure and establish standards for toxic contaminants. The process could take years.

In the meantime, just as they have already fouled the land and water in their communities, high-technology manufacturers continue to pour invisible poisonous gases into the atmosphere.

- Silicon Valley's mounting experience with high-tech pollution provides lessons for the literally hundreds of North American cities that hope to become new Silicon Valleys. Any community which hopes to share the benefits of electronics development must be prepared to pay the environmental or regulatory costs. Those communities which, desperate for jobs, relax their environmental standards, are making a terrible mistake. Not only are they risking environmental disaster, but they are unlikely to bring in additional investment. Most high-tech companies don't look closely at such regulations when making siting decisions.

In particular, would-be Silicon Valleys need to pre-

pare regulations covering the potential hazards of high tech before they invite the industry into their area. And they must develop the ability to enforce those rules competently before high-tech companies are ready to commence production. Communities are better protected and managers are happier when pollution control devices are built into plants from the ground up, rather than retrofitted by an arbitrary deadline. The engineers who manage electronics companies prefer dealing with public agencies that know precisely what they are controlling; they dislike working with regulators who act sympathetic but offer only vague guidelines.

In fact, some industry executives look favorably upon environmental protection. High-tech firms are more dependent upon brainpower than chemicals, and they must recruit professional workers from a worldwide job market. Silicon Valley is the world's leading center for high-tech industry, largely because it offers a quality of life which attracts these professionals. But if its water supply becomes permanently poisoned, few young scientists and engineers—especially those with children—will want to migrate to the Valley. This need to recruit skilled workers, more than any other factor, explains the industry's uniquely cooperative relationship with its regulators. How can an employer attract a key engineer from New York or a highly trained programmer from Oregon if the recruit knows that the local drinking water contains dangerous levels of industrial poison?

In the San Francisco Bay Area, where the environmental hazards of high tech are now well known, some residents remain dissatisfied with technical means of pollution control, such as double-walled containers, scrubbers, and pretreatment facilities. They have sought to limit their exposure by keeping high-tech production at a distance. Opponents of a Hewlett-Packard project in Rohnert Park, Sonoma County—a two-hour

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drive north of Silicon Valley—petitioned for a referendum that would have blocked construction. They lost the vote in April 1982, in part because Hewlett-Packard has one of the Silicon Valley's best reputations; but the company was forced to scale down its development plans to win approval.

In Silicon Valley itself, when the owners of a shopping mall announced in March 1983 that they intended to convert the entire complex to light industry, neighboring homeowners organized in opposition. The conversion was approved, but only on the condition that toxic use be reviewed by independent consultants and government. The neighbors still initiated a petition drive against the project; they dropped their campaign when Hewlett-Packard announced plans to lease the whole shopping center as a sales and training center, with no manufacturing.

When high tech does move into an area, it is also important to get regulatory agencies to work together. In Silicon Valley, both regulators and companies have been hobbled in their attempts to solve hazardous materials handling and disposal problems by the network of municipal, regional, state, and federal regulations. High-tech firms installed storage tanks underground to comply with fire regulations. They concealed vents to comply with municipal architectural standards, thus forcing toxic fumes back into facilities through the air-conditioning intakes. However, vapor scrubbers, which were installed to reduce air pollution, add to water pollution. And the processes designed to remove heavy metal wastes from liquid sewage precipitate them into much more stable chemical forms, requiring permanent land disposal. A study of Silicon Valley's environmental problems now being conducted by the EPA's Integrated Environmental Management Project should highlight the need for consistent regulation.

However, the future of effective protection depends primarily upon the willingness of authorities to work together.

In the long run, the solution to the high-tech toxic time bomb lies not in controlling pollution but in developing production techniques that will reduce the use of hazardous materials. Public regulatory policy should encourage the adoption of new, more environmentally sensitive production methods by making hazardous approaches more costly. For example, when the Air Quality Management District established tighter "photore-sist" process emission standards for Silicon Valley chip makers, it offered two methods which companies could use to achieve the District's goals. Wafer fabricators could either install costly new scrubbers or switch to a process requiring a smaller volume of chemicals.

Even in the best of circumstances, the threat of high-tech pollution will grow as production expands. New methods will bring new, unanticipated problems, as well as opportunities for improvement. The task of monitoring such hazards will require vigilance not only from public agencies and industry specialists but from the public and the press. The people of Silicon Valley, because of the tragedy of Los Paseos, appear to be aware of the problem, but massive public education is still necessary. Nationally, publicists and boosters have created a deceptively enticing image of the industry as clean and light. High-tech executives may be more willing than others to clean up their act once pollution is discovered; however, this only means that public pressure for both the prevention and clean-up of high-tech pollution *can* succeed. To generate that pressure, those outside high tech must keep tabs on the environmental impact of high-tech industry, or assuredly all of us will pay the costs.

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