From Clean Rooms to Dirty Water: Labor, Semiconductor Firms, and the Struggle over Pollution and Workplace Hazards in Silicon Valley

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FROM CLEANROOMS TO DIRTY WATER: LABOR, SEMICONDUCTOR FIRMS, AND THE STRUGGLE OVER POLLUTION AND WORKPLACE HAZARDS IN SILICON VALLEY

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Abstract

This article argues that labor activists initiated Silicon Valley's anti-toxics movement and were the driving force behind environmental remediation in the region in the first half of the 1980s. In order to unionize semiconductor plants, activists associated with SCCOSH and United Electrical, Radio, and Machine Workers, a left-wing union, attacked corporate negligence regarding worker safety and health. SCCOSH later allied itself with the Central Labor Council of Santa Clara County to push for the cleanup of aquifers contaminated by the semiconductor industry. The activists ultimately failed to organize Silicon Valley, but their campaigns led to a revolution in safety among microelectronics firms and to large-scale remediation efforts conducted under the EPA's Superfund program.

Introduction[1]

"In the last three years," the *New York Times* reported in November 1984, "nearly every major Silicon Valley chip maker has discovered that underground tanks filled with solvents had leaked – sometimes into the local drinking water. In October, the EPA proposed adding nineteen sites in the Valley to its Superfund list of sites the government identifies as particularly in need of cleanup. Included in the list are plants owned by the International Business Machines Corporation, the Fairchild Camera and Instrument Corporation, the National Semiconductor Corporation, TRW

Inc., Teledyne Inc., the Signetics Corporation, the Intel Corporation, Advanced Micro Devices Inc., and the Raytheon Company."[2] Over the next few years, the EPA added ten more Silicon Valley sites, many of them polluted by semiconductor firms, to its list, making Silicon Valley the region with the most Superfund sites in the nation. How did the semiconductor industry, that had the reputation of being particularly clean, become the source of a major environmental debacle? How was it discovered that the Valley was so polluted? How did firms, communities, and local governments address water contamination?

To answer these questions, this article reconstructs the semiconductor industry's chemical-handling practices and its changing attitude toward employee safety and environmental pollution. It also investigates the controversies that brought the region's health and water contamination crises to light in the late 1970s and the first half of the 1980s. These conflicts pitted the Santa Clara Center for Occupational Safety and Health (SCCOSH), the Silicon Valley Toxics Coalition (SVTC), and their allies in the labor movement against the Semiconductor Industry Association (SIA), large microelectronics firms, and computer corporations such as IBM. Other groups played an active role in these controversies and helped shape their outcome: newspaper reporters, neighborhood associations, fire departments, city and county governments, the Regional Water Resources Control Board, and Federal agencies such as EPA and OSHA.

Conflicts regarding industrial toxics were not specific to Silicon Valley. They appeared first in other regions. An early flash point was Love Canal, a white suburb

in New York State, where schools and an entire neighborhood were constructed on top of a toxic dump. Residents bitterly protested and fought for their relocation. Similar movements later emerged across the United States. For example, African American communities resisted the building of a landfill for PCBs in North Carolina and the construction of vinyl chloride plants in Louisiana. Residents of Riverside County in California also fought against a very large industrial dumpsite, the "Acid Pits," that spilled millions of gallons of liquid waste into nearby towns. Historians such as Robert Gottlieb have argued that these conflicts were part of a significant shift in the history of the environmental movement. Until then, well established national organizations such as the Sierra Club and the Audubon Society had dominated environmental politics. But with the anti-toxics movement, new, grassroots organizations emerged. They used aggressive tactics and focused on the prevention and reduction of pollution (unlike older organizations that sought to manage and control it). They also increasingly fought for environmental justice. Faced with community-based rebellions, polluting firms suppressed information and denied that they were the source of health hazards and environmental pollution. They also sought to crush their opponents. In the case of the vinyl chloride plants in Louisiana, the chemical industry went as far as taking control of the State supreme court and changing the rules governing academic law clinics to prevent the Environmental Law Clinic at Tulane University to give legal advice to the local anti-toxics movement.[3]

What was unusual about conflicts regarding toxics in Silicon Valley was that the battle there was spearheaded by labor activists.[4] They were the ones who originated environmental and occupational health activism and pushed for environmental cleanup in Silicon Valley. In order to unionize the semiconductor industry, they attacked microelectronics corporations for their poor safety record. This forced firms to tighten up their management of toxic substances and, in turn, revealed the massive contamination of the water table. Unions ultimately failed to organize the industry, but their drives led to a revolution in plant safety and massive remediation efforts. Surprisingly, the stakes behind the controversies on occupational health and environmental pollution in Silicon Valley – the unionization of the semiconductor industry - are not mentioned in the literature on this topic. In their historical accounts, Silicon Valley activists such as Ted Smith and Amanda Hawes downplayed their union ties, did not mention their primary goal, and forgot to tell that unionization drives eventually failed. Similarly, David Pellow and Lisa Park saw Silicon Valley's anti-toxics organizing mainly as a movement against environmental racism. Only Brian Mayer emphasized the alliance between labor and environmentalists in environmental struggles in Silicon Valley. But focusing mostly on the period after 1985, he did not investigate the central objective that led labor activists to focus on health and pollution issues in the first place. New historical evidence reveals that labor was the primary force behind the fight over pollution and occupational health in Silicon Valley and that the shift to environmental justice issues occurred later than previously thought. It came largely as a result of the failure to

organize semiconductor plants. Defeated by industry, labor activists gradually mutated into environmentalists and proponents of environmental justice.[5]

The argument proceeds as follows. In the late 1970s, young women associated with the Santa Clara Center for Occupational Safety and Health (SCCOSH) seized upon significant health and safety problems in the semiconductor industry to call for Silicon Valley's unionization. They were closely allied with a left-wing union, United Electrical, Radio, and Machine Workers of America (UE). In collaboration with the union, they campaigned against the use of toxic solvents in semiconductor plants, requested Federal investigations of microelectronics firms, and filed lawsuits against Silicon Valley corporations on behalf of injured workers. To defend themselves against SCCOSH and the UE, microelectronics corporations that had been negligent about the dangers of semiconductor manufacturing reformed their handling of hazardous chemicals. They built strong safety engineering groups and shared best practices across the industry. This region-wide safety program led to a significant drop in worker injuries and illnesses in the first half of the 1980s.

But as they made their plants safer and tracked toxics more carefully, corporations discovered that underground tanks, where they stored chemicals, had leaked vast amounts of solvents into the region's aquifers. The matter may have received limited public attention, had it not raised the ire of mothers, who had drunk contaminated water and blamed toxic exposure for their children's birth defects. The scandal caught the eye of SCCOSH activists, who saw it as an opportunity to give new life to their unionization drive. In close collaboration with the Central Labor

Council of Santa Clara County, they formed the Silicon Valley Toxics Coalition (SVTC) to force corporations to decontaminate aquifers and build community support for the organizing of the semiconductor industry. SVTC inserted itself into local negotiations on the regulation of chemical storage. It pressured the Federal government to intervene, which led the EPA to put many Silicon Valley sites on its list of Superfunds. Thus, a controversy started by labor activists, with the objective of unionizing Silicon Valley, led to the discovery of water pollution and large-scale remediation programs under Federal supervision.

The culture of negligence

Ever since its formation in the 1950s, the semiconductor industry presented itself as a clean industry, without dirty manufacturing processes and smokestacks belching dangerous fumes. Its manufacturing spaces, also called cleanrooms, were widely heralded as being cleaner than surgical wards. Semiconductor firms' managers and public relations departments often repeated this story to newspapermen, fire chiefs, zoning specialists, and city and county officials. By the 1970s, it was a widely accepted truth in Silicon Valley that the semiconductor industry was a clean, harmless industry. This truth was inscribed into local zoning regulations. Semiconductor manufacturing was zoned as "light manufacturing" and, in some cities such as San Jose and Mountain View, semiconductor plants could be built in

close proximity to residential neighborhoods. It was not uncommon to see middle class families living across the street from factories making microchips.

This image and discourse of cleanliness did not fit with the realities of semiconductor manufacturing. The microelectronics industry was first and foremost a chemical industry. The production of microchips relied on the massive use of highly toxic chemicals. Firms employed arsine and phosphine, gases used in trench warfare during World War I, to dope silicon crystals and form the intricate electronic structures characteristic of microchips. Also important for chip production were powerful acids that etched the top layers of silicon wafers. Another category of chemicals routinely used in microelectronics was solvents such as TCE, TCA, glycol ethers, and the CFCs. These solvents helped clean silicon wafers after each process step (and there were hundreds of these steps in the production of a single microchip). They were highly flammable and dispersed quickly in water. In 1980, the semiconductor industry in Silicon Valley used more than half a million gallons of solvents and two million gallons of acids to manufacture microchips.[6]

From the mid-1950s to the late 1970s, most managers of semiconductor corporations in Silicon Valley approached chemical handling and its dangers in a rather cavalier manner. Federal, state and local regulations were lax and, if they existed (as for air pollution and the prevention of chemical fires), they were not always enforced in the 1960s and much of the 1970s. Microelectronics corporations also were entrepreneurial firms. The primary goal of their managers was to innovate new products and technologies, grow sales very quickly, and sell shares on the stock

market. Worker health and environmental protection were low priorities. There were exceptions, however, such as Gordon Moore, Fairchild's co-founder, who cared about chemical safety and directed analytical chemists in his laboratory to work on industrial hygiene issues in the early and mid-1960s. Although several microelectronics corporations such as Intel, AMD, and National Semiconductor grew very large, the entrepreneurial, "wild-west" attitude, characteristic of their start-up days, remained. By the mid-1970s, large corporations managed toxics in ways that closely resembled their practices a decade earlier. But the volume of chemicals they used had increased very substantially.[7]

Another factor explaining the industry's lax attitude was partial ignorance of the health effects of many of the chemicals used in semiconductor manufacturing. A subsequent lawsuit has revealed that IBM had done toxicological studies on chemicals used in electronics manufacturing and knew as early as the 1950s that many had adverse health effects. But, as far as it can be inferred from the historical record, this knowledge was not shared with semiconductor firms. It was later in the 1970s and 1980s that university-based researchers discovered that many solvents caused cancer in animals and that, in the case of the CFCs, they depleted the ozone layer. Epidemiological studies confirmed these findings.[8]

Microelectronics firms addressed safety and health issues mainly through safety committees. These committees were made up of volunteers working in the fabs. None had been trained in industrial hygiene or safety engineering. Manufacturing managers would call on safety committees to investigate accidents

and suggest changes in equipment and procedures. The safety committees also regularly toured manufacturing facilities and could propose safety changes. But the final decision remained in the hand of the fab manager or his direct reports. In other words, safety committees had little power in most Silicon Valley corporations. The imperatives of production trumped safety considerations.[9]

As a result of the relative powerlessness of safety committees and the low priority granted by top management and manufacturing managers to worker health and safety, safety precautions were decidedly limited. Workers received little training in the handling of chemicals. Many firms made protective gear, such as gloves, lab coats, and glasses, available to workers. But as much as it can be determined from photographs taken in the 1960s and 1970s, they were not always worn and the protection they offered was slim. Firms did not monitor chemicals in the air either. The only safety control was smell and evacuation in case of an unusual odor. In some egregious cases, manufacturing managers ordered workers, whom they knew to be sensitive to chemicals, to walk through the plant and report the presence of toxics in the air.[10]

Semiconductor work was a dangerous occupation. A study made by the California Department of Industrial Relations in 1980 pointed out that the illness rate in the microelectronics industry was three times higher than the average for all industries in California. Many illnesses involved acid burns. A flask of acid would fall, a silicon wafer would drop accidentally into a chemical bath, and operators nearby (if they did not wear protection, which was often the case) would get splashes

of acid onto their skin or into their eyes. These accidents were often serious, as some acids burrowed deeply into bones and soft tissues.[11]

But the most insidious danger was the inhalation of noxious fumes. Workers breathed toxics during chemical spills. They inhaled dangerous chemicals released by micro-leaks in pipes carrying toxic gases. Another health hazard was defective ventilation systems. Since the production of microchips required great air cleanliness, semiconductor firms ventilated their cleanrooms. But air intakes were often located close to smokestacks, and they would bring chemicals just released into the atmosphere back inside the plant. This problem was considerably aggravated by local building regulations. Cities, such as Sunnyvale, wanted semiconductor fabs to look as unfactory-like as possible. As a result, they required that a high parapet be built around the plants' rooftop in order to hide the smokestacks. This rule had the unanticipated consequence of trapping dangerous chemicals on top of the buildings, creating thereby "chemical pools." As the air intakes, like smokestacks, were located on top of the roofs, the chemicals would be swallowed back in by the ventilation systems and breathed, again and again, by operators and technicians working in the cleanrooms. In order to cut down on energy costs (that increased considerably after the 1973 oil crisis), some corporations also re-circulated the air inside the factories, thereby exposing operators to the same chemicals, multiple times.[12]

The general attitude of many managers regarding these dangers was characterized by a mix of denial and suppression. When workers, who were overwhelmingly women, complained about safety conditions, managers often

dismissed their concerns as "female hysteria." After plant evacuations, manufacturing supervisors called in occupational physicians to "calm down the workers" and convince them to go back to work. Operators, who were too vocal about safety, were dismissed. Several firms went as far as setting up an occupational clinic, the California Industrial Medical Clinic, to better control the reporting of medical injuries and the filing of workers' compensation claims. The clinic treated thousands of workers every year. It had the reputation of downplaying exposure to chemicals and sending operators back to work as soon as possible. Its doctors often refused to put in compensation claims for injured workers, as these claims would adversely affect the corporations' finances.[13]

Managers of microelectronics firms gave an even lower priority to environmental protection. Indeed, the environmental impact of semiconductor manufacturing was not an issue. It was a "clean industry." Applying fire prevention regulations adopted in 1939, semiconductor corporations stored flammable chemicals, including solvents, in underground tanks. In a 1983 survey, the Regional Water Resources Control Board, the agency responsible for the quality of the water supply, identified 258 such tanks in Silicon Valley, at 96 different industrial sites. Firms barely monitored these tanks. Little care was also exercised in the handling of chemicals around them. Operators overfilled the tanks, causing spills. They emptied hoses from delivery trucks on the ground. More importantly, they poured incompatible chemicals into the same tank, which — as it was found out later — caused substantial leaks.[14]

If storing procedures were lax, those for disposal showed even less appreciation for the environment. Microelectronics firms routinely dumped acids and solvents into sewers in the 1960s and 1970s. When a crew dug up the sewer lines at Intel's first facility in Mountain View, they discovered that all pipes had a U-shape. Their bottom had been eaten up by acids. Once released into sewers, the chemicals found their way into the San Francisco Bay. In 1976, a Santa Clara County report also pointed out that the industry deposited toxic chemicals into city dumps and poured them into pits and drywells (instead of depositing them at two special facilities for hazardous chemicals in the Bay Area). This report is corroborated by the testimonies of operators, who described the disposal of used solvents onto the ground of industrial facilities. As early as 1980, these operators also asserted that electronic chemicals contaminated wells and aquifers.[15]

Starting in the mid-1970s, a few corporations gave more attention to environmental issues and the health and safety of workers. This new attitude can be partially explained by the evolving legal and regulatory environment. In 1970, the Nixon administration established the Environmental Protection Agency. Congress also passed the Occupational Health and Safety Act, which gave the Federalgovernment general oversight of the workplace and created a new Federal agency, the Occupational Safety and Health Administration (OSHA). Three years later, the State of California created its own Occupational Safety and Health Administration, Cal-OSHA; and in 1976, the State legislature passed a law requiring counties to plan for the disposal of toxic waste. It took several years for these acts to

register in Silicon Valley. But by the mid-1970s, fearing the scrutiny of NIOSH, OSHA's investigative branch, firms started to put greater emphasis on safety. Some corporations such as Signetics reinforced their safety committees, stepped up safety inspections, and established chemical handling classes. In their employee newsletters, they also urged workers to give more attention to safety. Other firms hired their first safety engineers. For example, in 1976, Intel recruited a safety engineer, Ed Sawicki, who built a modest safety program in the next few years. Companies adjusted slowly to new environmental regulations.[16]

Organizing through safety and health

It is very likely that corporate negligence would not have come to light had it not been for a group of young women who publicized it in the late 1970s and early 1980s. They were Amanda Hawes, a Harvard-trained lawyer who had worked with the Cannery Workers Committee, a radical union, and represented injured workers and elderly people forced out of their houses by redevelopment projects in San Francisco; Robin Baker, who had a public health background; and Patricia Lamborn, a union activist, who had tried, unsuccessfully, to organize a National Semiconductor plant for United Electrical, Radio, and Machine Workers (UE) in the mid-1970s. UE was a left-wing union that had been expelled from the AFL-CIO because of its communist ties. Since the early 1970s, in an effort to expand from its base in the East Coast, it had sought to organize semiconductor plants in Silicon Valley. The three women met at

the Pacific Studies Center, a New Left think tank and hub of social activism located in Mountain View. The Pacific Studies Center had been created in 1969 by Lenny Siegel, a former SDS leader and critic of the Vietnam War at nearby Stanford University. Thus, the group that brought the fight on toxics to Silicon Valley coalesced at the convergence point of several social and political movements: the New Left, the student movement, and the radical wing of organized labor. It was also inspired by the feminist and environmental sensibilities that grew out of the struggles of the 1960s.[17]

Hawes, Lamborn, and Baker viewed safety and health as the wedge that would help them unionize the semiconductor industry. In Silicon Valley, unions represented municipal workers, the building trades, and workers at large military contractors such as Lockheed. But they had consistently failed to organize the electronics industry, the main source of employment in the region. In the 1940s and 1950s, trade unions had attempted, unsuccessfully, to organize electron tube and electronic testing corporations. Starting in the mid-1960s, they focused on semiconductor manufacturing. This was the Valley's fastest growing industry. Employment in semiconductors expanded from less than 4,000 workers in 1964 to 25,000 in 1974 and 53,000 in 1982. In their organizing drives, unions emphasized pay, benefits, and job security. But they found that these traditional issues did not resonate well with workers. Semiconductor firms expanded very quickly, which created some job security and opened up opportunities for upward mobility. Indeed, it was not uncommon for operators to become "lead-girls" or technicians. Chasing

better wages, workers also moved from firm to firm, thereby undermining all organization drives. Another obstacle was the changing composition of the workforce. It was increasingly made of immigrant women from the Philippines, South Korea, and Central America who often spoke little English and for whom the ways of American unions were entirely foreign.[18]

In addition, managers of semiconductor corporations mounted vigorous defenses against organized labor. In their view, unions were a major threat. They would damage their firms' competitiveness and prevent rapid adjustments to technological and market changes. Union representation would also preclude the imposition of a very tight discipline on the workforce that managers deemed essential for the control of very complex manufacturing processes. In contrast with the type of industrial relations promoted by unions, the executives of microelectronics corporations and their human resources staffs stressed solidarity between workers and managers. They encouraged the opening of strong communication channels between management and the industrial workforce. They granted fairly liberal benefits, rewarded employees with stock options, and, advertised their interest in the welfare of their labor force. Signetics, for instance, promoted itself as the "good people company." When they faced organizing drives, managers of semiconductor firms hired union-busting lawyers and used every tool in the trade to stave off unionization. In every election from the early 1960s to the late 1970s, they defeated the trade unions.[19]

But Lamborn, Hawes, and Baker had discovered that health hazards did concern Silicon Valley workers. While employed as a solderer at National Semiconductor, Lamborn had herself suffered from chemical exposure. She had also noticed that her co-workers were frightened by fires, chemical spills, and malodorous fumes. Fellow UE organizers seeking to organize Fairchild's plants had made the same observation and emphasized the dangers of semiconductor work in their campaigns in 1976 and 1977. Their sense that chemical dangers could mobilize electronics workers was confirmed by a hotline that Lamborn, Hawes, and Baker set up in collaboration with UCSF researchers at the Pacific Studies Center in September 1977. The hotline's objective was to recruit female workers for a study on the impact of TCE on breast cancer. The line received hundreds of phone calls from concerned operators. The trio was now persuaded that the denunciation of chemical hazards offered a new way of mobilizing workers and organizing semiconductor fabs. Aside from UE organizers at Fairchild, they were the first ones in the labor movement in Northern California to come to that conclusion. A new generation of UE activists around David Bacon at Signetics and National Semiconductor soon embraced this tactic. But it was a few years later that the local branches of international unions affiliated with the AFL-CIO adopted a similar stance.[20]

In October 1978, Hawes, Lamborn, and Baker started the Project on Health and Safety in Electronics (PHASE) at the Pacific Studies Center to increase employee awareness of occupational safety and health in Silicon Valley. PHASE was funded by a large grant from Federal OSHA. Because of Federal rules forbidding the use of

government funds for partisan purposes, they soon established another organization, the Electronics Committee for Occupational Safety and Health (ECOSH) that was openly pro-union. To bring these projects together, in August 1979 the three women established the Santa Clara Center for Occupational Safety and Health (SCCOSH), an umbrella organization headed by Hawes. They were inspired to do so by the recent creation of coalitions for occupational safety and health (COSH) in Illinois, Pennsylvania, and Massachusetts. These coalitions, set up by New Left activists, researched workplace hazards and made their expertise available to workers.[21]

Directed by Baker, PHASE gathered information on the chemicals employed in semiconductor manufacturing (which were then unknown outside the industry). Baker created a hotline for electronics workers to learn about the chemicals used in microelectronics from them. She also recruited one of the first industrial hygienists ever employed in Silicon Valley. The hygienist identified chemical compounds under their trade names and researched their health effects in the medical literature. The end product was a series of detailed leaflets on the main chemicals used in microelectronics manufacturing, which PHASE distributed widely in Silicon Valley. PHASE also organized workshops to make this information more commonly known. For Hawes, Lamborn, and Baker, this research, data-gathering, and educational effort was a way of breaking the industry's monopoly on information. It also enabled them to feed ECOSH with accurate information about the dangers faced by workers in semiconductor fabs.[22]

ECOSH, run by Lamborn, operated with small grants from liberal foundations and the Catholic Church. Its primary purpose was to publicize the hazards of semiconductor manufacturing, provide legal assistance to disabled workers, and pave the way for the unionization of Silicon Valley. "Our long term goals are the strengthening of the labor movement in Silicon Valley and the organization and empowerment of the unorganized electronics workers," Lamborn wrote to the Campaign for Human Development, the Catholic Church's anti-poverty program that financed ECOSH. "We believe the concrete struggle for safe and healthy working conditions is laying the groundwork for the eventual unionization of electronics workers."[23] To advance its goal of unionizing Silicon Valley, ECOSH collaborated closely with United Electrical Workers. It provided direct assistance to its organizing of the semiconductor industry. For example, Lamborn and other SCCOSH activists distributed leaflets on chemical hazards in front of the gates of the factories targeted by the union, especially MAD, Signetics, and National Semiconductor. PHASE seconded these activities by urging operators, who called its hotline, to contact UE organizing committees at their plants.[24]

ECOSH and UE also waged a campaign to ban TCE, a solvent employed to degrease electronic components. TCE was a good target. Recent studies had shown that it caused cancer in animals. It was widely utilized in the semiconductor industry, but its use was on the decline, as a number of firms were phasing it out and replacing it with another solvent, TCA. Starting in June 1979, ECOSH and UE agitated against TCE to publicize the dangers of electronics work and suggest that

unions would guarantee better health and safety conditions for electronics workers. In collaboration with the UE and other unions, ECOSH later requested that Cal-OSHA ban the solvent. They also demanded that the agency make regular workplace inspections to check for TCE use and that it lower the standard for TCA. Cal-OSHA responded to this request by lowering the permitted exposure level to TCE by 75%.[25]

But the ECOSH project that was the most influential was its legal representation of three Signetics employees: Marta Rojas, Cathi Hee, and Cathy Bauerle. These young women worked as technicians in Signetics' research laboratory. In the laboratory, they were exposed to toxic chemicals. As it was later found out, the ventilation system was defective. The air intake was so close to the smokestack that it brought toxic fumes into their work area. They became so sensitized to chemicals that they refused to work in the lab starting in August 1978. To hide their case and avoid reporting hundreds of lost days to OSHA, Signetics managers assigned Rojas, Hee, and Bauerle to the cafeteria, where they did nothing for nearly a year. Their only task was to walk through the cleanrooms to sense toxic chemicals in the air. They acted like the canaries of nineteenth century coal mines that helped detect potential firedamp explosions.[26]

Infuriated by the way in which they were treated by their employer, Rojas, Hee, and Bauerle contacted Hawes and Lamborn. In March 1979, they asked them to file a request for a NIOSH hazard investigation and they designated ECOSH to be their representative in this investigation. In retaliation, Signetics, which was deeply anti-union and did not want NIOSH to meddle into its affairs, fired the three women.

This led to a protracted legal battle. Hawes filed several lawsuits against Signetics on these women's behalf, including a lawsuit for job discrimination and a class action lawsuit requesting $25 million in damages from the firm. This high profile case attracted the attention of Susan Yoachum, a very young and ambitious reporter from the *San Jose Mercury News*. In the next few years, Yoachum published a series of articles on the Signetics technicians, including an in-depth piece on "The Chemical Handlers" in April 1980 that castigated semiconductor corporations for their safety lapses. These articles attracted considerable attention in Silicon Valley.[27]

Yoachum's articles instigated a flurry of lawsuits by workers alleging toxic exposure. Operators and technicians, who had been hurt on the job and denied financial compensation, also increasingly sued their former employers. This was especially the case at Signetics, where employees were emboldened to go to court by the example of the three technicians. The epidemic reached other corporations: Fairchild, Intel, AMD, National, Intersil, AMI, and Monolithic Memories. By 1982, all microelectronics companies in Silicon Valley had to contend with a significant number of employee lawsuits. The legal business boomed. Hawes handled 50 workers' compensation cases in 1984. Another lawyer specialized in workers' compensation saw his caseload increase from a few cases in 1979 to 350 in 1984.[28]

Nearly as threatening for corporations was increasing scrutiny from local governments and State and Federal agencies. Cal-OSHA and NIOSH, which until that time had ignored semiconductor manufacturing, conducted investigations of the industry and of individual firms. At SCCOSH's request, NIOSH investigated

Signetics' and AMD's plants. It also examined Intel's fabs. In addition, NIOSH did an industry-wide study on the health hazards of semiconductor work, as did Cal-OSHA. Even more worrying for the industry was the growing attention it garnered from fire departments and city governments. Soon after the Rojas, Hee, and Bauerle case became public, the Sunnyvale fire department conducted detailed surveys of Signetics' fabs. It identified more than nine hundred fire code violations. Sunnyvale's fire chief threatened to close down six Signetics plants, if these violations were not addressed very quickly. This amounted to a death threat, as the corporation did the majority of its production in Sunnyvale. Then, Sunnyvale's city council intervened. It imposed a four-month moratorium on further industrial development in 1980. It later restricted industrial activity, by requiring that no more than 45 employees could work per acre within city limits. This measure threatened the further expansion of the semiconductor industry in one of the Valley's largest industrial towns.[29]

The corporate response

Microelectronics firms responded to attacks from UE and SCCOSH and growing scrutiny from the press and local governments by organizing elaborate public relations campaigns and manipulating the reporting of health information. These activities were orchestrated by the Semiconductor Industry Association (SIA), the organization representing the chief executive officers of semiconductor corporations. The industry financed reports affirming that it was one of the safest industries in

America. It also changed the ways in which it reported injuries and illnesses to the Federal government. This was in response to the report of the California Department of Industrial Relations showing that the illness rate in semiconductors was three times higher than the average for all industries in California. To significantly reduce their illness rate, microelectronics firms categorized incidents until then considered to be "illnesses," such as acid burns, as "accidents." Other types of illnesses were dropped altogether and never reported to the Federal government. Not surprisingly, the illness rate of the industry as a whole decreased very significantly, supporting its assertion that it was very safe indeed.[30]

Corporations also sought to crush SCCOSH by draining its finances. In 1979, twenty-five Silicon Valley companies asked Federal OSHA to cut off the PHASE grant, arguing that Federal dollars were spent for union organizing. Their request was turned down and the grant substantially increased. But after Ronald Reagan's election, firms tried once again to have the grant rescinded. This time, they succeeded. Within three months of Reagan's inauguration, the new OSHA leadership that was openly pro-business cancelled the grant. This was a major blow for Hawes, Lamborn, and Baker. Without funding, PHASE laid-off its staff. Baker left soon afterwards. ECOSH, which had independent sources of funding, continued to operate, however, under the SCCOSH name. It remained a significant source of concern for semiconductor firms.[31]

Silicon Valley managers knew that in order to avoid unionization, they had to address the hazards of semiconductor manufacturing directly and forcefully. Some

were also genuinely concerned by the dangers faced by workers in the cleanrooms. For example, a major force for making the plants safer at Signetics was Donald Liddie, the vice-president of corporate services. He bemoaned the fact that the Signetics leadership had, as he put it, long "underestimated the safety/environmental issues in wafer fabrication areas."[32] Starting in 1979, Liddie and the top managers of other semiconductor firms considerably stepped up their corporations' safety programs. They devoted large budgets to occupational safety and health. They established safety departments and gave them the mandate of increasing employee safety and protecting firms against unions and lawsuits.[33] To staff these departments, they hired teams of safety professionals: safety engineers, industrial hygienists, and fire prevention experts. The newcomers came from Federal OSHA, Cal-OSHA, and the safety staffs of Eastern and Midwestern corporations. For example, AMD recruited an experienced industrial hygienist, who had directed Cal-OSHA's study on the semiconductor industry, as their first safety director. Signetics hired more than ten safety professionals. Among them were an industrial hygienist, who had worked for Federal OSHA, and a Ph.D. chemist who had set up an industrial hygiene laboratory for Duracell in Boston.[34]

The new recruits brought in professional values, a definite interest in the safety of workers, and a great familiarity with the inner workings of regulatory agencies. By their very presence and the fact that they had direct lines of communication with the firms' top management, they changed the internal dynamics of many corporations. They acted as a counterweight to manufacturing managers,

who cared more about yields and production deadlines than about health and safety. This often led to conflicts between the safety engineering groups and the managers of semiconductor fabs. When the safety engineers were backed by top executives, as they were at Signetics and Intel (headed by Moore), they won many of these battles. They were somewhat less successful at other corporations such as National Semiconductor and Monolithic Memories, where production efficiency remained the main priority. There, safety engineers and industrial hygienists had less latitude to transform their firms' approach to health and safety.[35]

Within a few years, the new safety and engineering groups deeply reformed the ways in which most firms managed toxic chemicals. They developed mandatory chemical-handling training programs for workers and technicians. They set up in-house industrial hygiene laboratories that analyzed air samples coming from the plants. They outfitted emergency vehicles and trained teams to deal with chemical spills and accidents. They also addressed chemical hazards with new technology. For example, they developed novel ways of handling and detecting toxic gases. Because pipes carrying toxic gases often had micro-leaks, they used double piping. They also connected pipes by welding them, rather than by employing flanges that were leaky. Another area of concern was the detection of chemicals in the air of cleanrooms. Until the late 1970s, the detection of dangerous fumes had been through smell, or more infamously, by sending workers who were highly sensitive to chemicals to the fabs and seeing how their bodies reacted. Starting in 1980, some firms, especially Intel and Signetics, installed microprocessor-controlled sensors that analyzed air in the plants.

Industrial hygienists and safety engineers evaluated these sensors and learned how to make them work. The sensors drifted and required constant recalibration. But they did increasingly identify toxic chemicals. Safety programs, first developed for Silicon Valley fabs, were transferred to the corporations' other manufacturing facilities in the United States and overseas.[36]

To share safety advances across Silicon Valley firms, Ed Sawicki, Intel's safety manager, Lee Neal, his counterpart at Fairchild, and the safety manager of Memorex, a manufacturer of hard disk drives, set up the Bay Area electronics safety group. "A lot of people were trying to reinvent the wheel," Sawicki explained to a reporter in the spring of 1980. "Since everybody used the same chemicals and bought the same equipment, we decided that it was time for the industry to share health and safety information. We are not in competition on health and safety issues."[37] For much of the 1980s, the association functioned as the primary vehicle for the sharing of safety programs developed by the larger corporations with smaller firms that did not have the same resources to devote to safety. When engineers working at Motorola and Texas Instruments indicated their interest in joining the organization, the Bay Area electronics safety group evolved into SESHA, a national professional society for safety engineers in the semiconductor industry.[38]

The thorough rethinking of safety protections and the sharing of safety programs across the industry had significant results. They considerably eased firms' relations with Federal OSHA and Cal-OSHA. NIOSH and Cal-OSHA had launched surprise investigations of Signetics', AMD's, and Intel's fabs in the early 1980s, but

ceased to do so in the years following. The safety programs also limited the number of new lawsuits filed by employees and helped corporations prevail in almost all of the pending court cases. For example, Signetics won most of the high-profile lawsuits filed by Hawes for the Signetics technicians. More importantly, the safety programs undermined the claims made by UE and SCCOSH. The union was also weakened by the firing of its leaders. For example, David Bacon was dismissed, as were the great majority of fellow UE activists at Signetics and National Semiconductor. They were also blacklisted. Some had to leave Silicon Valley in order to find work. By the summer of 1982, UE was no longer a significant threat for microelectronics corporations. Semiconductor fabs also became much safer. This was especially the case at Signetics. Between 1979 and 1983, the number of new workers' compensation cases at Signetics dropped from 870 to 108. Similarly, the cumulative number of work days lost to injuries decreased from 848 to 417 between 1981 and 1983. Semiconductor firms had accomplished a revolution in safety. They had done so to defend themselves against SCCOSH and the unions.[39]

Water contamination

As corporations tightened their chemical handling procedures, new problems surfaced, this time with the leaking of solvents into the ground. In the fall of 1981, Neal, the safety director at Fairchild, organized an inspection of the firm's new microchip plant in South San Jose. According to Neal, he and his team went through

the facility and discovered that its 4,000 gallon-waste solvent tank was empty. It had leaked all its chemicals into the ground. The mix of chemicals in the tank had dissolved holes in its fiberglass walls. It was later found out that the leak had been unattended for at least a year and a half and that it had released more than 55,000 gallons of TCA, xylene, and acetone into the ground. This finding was the beginning of a major scandal that shook microelectronics corporations and forced them to step up their environmental programs, as they had done earlier for safety.[40]

In early December, Fairchild reported the leak to the Regional Water Resources Control Board, the State agency responsible for the protection of water quality, and to the Great Oaks Water Company, a small firm selling water pumped from the local aquifer to San Jose residents. It was found within days that Fairchild's chemicals had contaminated the deep aquifer and that water in a nearby drinking well operated by the Great Oaks Water Company was full of TCA. This was ominous news for Great Oaks and the Water Resources Control Board. But the Board remained largely inactive, assigning only one staffer to the problem, even though much of the population of San Jose, Silicon Valley's largest city, was drinking water from this aquifer. In January 1982, the story appeared in a short and innocuous article in the *San Jose Mercury News*.[41]

The matter might have quickly disappeared from public view, had the article not been read by Lorraine Ross, a young woman living with her family in the Los Paseos neighborhood, a middle class neighborhood located right across the street from the Fairchild plant. She had given birth a few months earlier to a baby daughter

with a congenital heart defect. The *San Jose Mercury News* article led Ross to wonder whether there was a connection between the chemical leak and her daughter's condition. She talked to her neighbors and found out that many families in the neighborhood had similar health problems: miscarriages, stillbirths, and infants with severe birth defects. She then published an open letter to San Jose's mayor, Janet Hayes, in the *San Jose Mercury News*, asking her to intervene. She wanted public action. Soon, other Los Paseos residents inundated county health officials with phone calls, reporting other cases of miscarriages and congenital defects.[42]

Capitalizing on this anxiety and anger, Ross mobilized the neighborhood. She made use of the skills she had developed while organizing protests against the war in Cambodia at San Jose State University in the late 1960s. Ross set up community meetings that demanded redress from Fairchild, new rules regarding chemical storage, and an official investigation of congenital defects. Fairchild's spokesman responded by arguing that no direct link between TCA and birth defects had ever been proven and that a little bit of chemicals in drinking water did not hurt anybody. This only fanned the residents' outrage. Susan Yoachum, the reporter who had covered safety issues in the semiconductor industry for the *San Jose Mercury News*, took on the story and, in almost daily articles from March to May 1982, reported on the chemical leaks and Ross's battle with Fairchild, giving considerable publicity to the water contamination scandal in Silicon Valley.[43]

The scandal caught the eyes of Amanda Hawes and Patricia Lamborn of SCCOSH. They attended community meetings in the Los Paseos neighborhood and

distributed leaflets prepared by PHASE on toxic chemicals used in the semiconductor industry. Soon, Hawes and Ross became involved in drafting legal strategies against Fairchild and the Regional Water Resources Control Board. In April 1982, Hawes and other lawyers filed a class action lawsuit against the Board on behalf of more than one hundred and fifty Los Paseos residents. They claimed that the Board had failed to protect drinking water, exposing residents to a variety of illnesses in addition to birth injuries and miscarriages. Hawes and her colleagues also filed a much larger class action lawsuit against Fairchild. This lawsuit was later merged with other court actions against Great Oaks, IBM (the source of another major solvent spill in the neighborhood), and the manufacturer and installer of Fairchild's waste solvent tank. In 1985, the State department of health published a study arguing that the rate of miscarriages and birth defects was three times higher in the Los Paseos neighborhood than the California average. This report and continuing adverse publicity persuaded Fairchild, IBM, and the other defendants to settle the suit in 1986. The plaintiffs obtained a very large financial settlement, the amount of which remained secret at the companies' request.[44]

The water contamination scandal did not stop with the lawsuits. It greatly amplified for much of 1982 and 1983. As the Great Oaks Water company inspected its other drinking wells, it discovered that a quarter of them had TCA. The firm had to close down these wells. At the request of San Jose's mayor, water authorities in Santa Clara County tested one hundred and eighty drinking wells in the spring of 1982. They found that many were tainted with chemicals. Concerned by possible civil and

criminal liabilities, large microelectronics corporations such as Intel and Signetics also did their own environmental studies (they employed their newly established industrial hygiene laboratories to do so). They found that their solvent tanks had leaked as well. Knowing that they had everything to lose if they withdrew this information from the public, they organized press conferences to share the bad news. Stories on water pollution appeared in local papers nearly every day in 1982 and 1983.[45]

This relentless stream of bad news and the Los Paseos residents' lawsuit forced the Regional Water Resources Control Board, at long last, to spring into action. Starting in May 1982, the Board did an exhaustive study of buried solvent tanks in the Santa Clara water basin. It surveyed these tanks and found more than 250 of them. It then forced companies, those that had not done it yet, to drill holes to various depths around the tanks and take soil and water samples from them. By the time it completed its study in July 1983, the Board found that 75% of the tanks had contaminated soil or ground water around them. This study also helped identify ninety-eight additional cases of contamination of the water table. Overall, between 1981 and 1984, high tech corporations, the Santa Clara water authority, and the Water Resources Control Board found a hundred and fifty sources of aquifer pollution in Silicon Valley.[46]

The growing number of polluted sites came as a major surprise to engineers and managers working in the semiconductor industry. "I was shocked," an AMD engineer later recalled. "Everybody was. We had all considered the chip industry to

be super-clean, all being proved by our smokeless chimneys, clean green lawns, and nice-looking buildings. The leaking solvents problem surprised everyone in the Valley."[47] The top management of microelectronics corporations responded to this emergency, very much in the same way as they had reacted to the chemical exposure scandal at Signetics. Starting in 1982, they recruited environmental engineers and built environmental departments to manage site cleanup, negotiate with regulatory agencies, and mount legal and public relations defenses.[48]

They also hired environmental engineering firms to limit the plumes' expansion and diminish their chemical concentration. In the case of Fairchild, this meant constructing a clay wall around the chemical plume, 80 to 140 feet down, in order to cordon it off. This was done at enormous expense: $25 million between 1981 and 1986, enough to seriously depress the financial results of an ailing corporation. Although most firms did not face the same technical challenges as Fairchild, they had to invest heavily in decontamination. It was estimated that Silicon Valley corporations spent $70 million between January 1982 and July 1984 to stop chemical leaks and start remediation. This proved to be a significant financial burden for firms that, at that time, faced fierce competition from the Japanese and were often on the edge on bankruptcy. The timescale of the cleanup effort was also daunting. Fairchild and the other corporations had to continuously pump contaminated water, blow it through charcoal filters to capture the unwanted chemicals, and pump it back into the ground. They would have to go through that cycle for many decades in order to decontaminate the aquifers. The scale of the problem and its gravity - the

contamination of drinking water in the southern part of Silicon Valley - considerably deteriorated the public image and credibility of microelectronics firms.[49]

Labor and environmental cleanup

Exploiting this political weakness, Hawes and Lamborn of SCCOSH brought their struggle with industry to a new front: communities and local governments. They thought that SCCOSH could capitalize on public outrage regarding water pollution to bring workers and community residents together in a battle against toxics. In their eyes, this would create a favorable environment for the eventual unionization of the semiconductor industry. Community support would strengthen unions in their organizing of Silicon Valley firms. As Lamborn put it, the objective was to use the environmental debacle to "set up viable organizations and coalitions to lay the groundwork for the eventual unionization of the electronics industry."[50] Sharing this objective was Ted Smith, Hawes' husband. Smith had worked as a community organizer in Washington, D.C. and studied law at Stanford. He practiced labor law and was well introduced in union circles in San Jose. With Smith, the SCCOSH leadership envisioned a coalition bringing together labor, chemically disabled workers, church groups, neighborhood associations, and environmental organizations.[51]

To construct this coalition, in the summer of 1982 Hawes and Lamborn allied themselves with Peter Cervantes-Gautschi, the leader of the Central Labor Council of

Santa Clara County, to start a new SCCOSH project, the Silicon Valley Toxics Coalition (SVTC), headed by Smith. The Central Labor Council was the representative body of union locals affiliated with the AFL-CIO. Up until then, unlike United Electrical, Radio, and Machine Workers, the council had shown little interest in SCCOSH's activities and in occupational health and environmental pollution. But the situation changed in 1982. This was partially due to a concerted effort by Lamborn and SCCOSH to court the labor council. After UE's demise, they needed a new labor ally in order to make progress on their goal to unionize Silicon Valley. "SCCOSH supports the organization of electronics workers as the primary means of improving their working conditions," Lamborn reported to her patrons in 1982. "To this end, we have worked hard in improving our working relations with a number of international unions interested in organizing in this area."[52] The Central Labor Council also experienced a change in leadership at that time. Peter Cervantes-Gautschi, who embraced SCCOSH's strategy of focusing on occupational health and environmental pollution, became the council's business manager. He was intent on unionizing the electronics industry. Under his watch, the council supported a unionization campaign by the Glaziers union at Atari. It also lent its organizational capabilities to SVTC and financed SCCOSH through donations from union locals. Cervantes-Gautschi chaired SVTC's board.[53]

Also part of the coalition were disabled electronics workers organized by SCCOSH and the group of Los Paseos residents around Lorraine Ross (this group, which may have otherwise originated a grassroots, anti-toxics movement in Silicon

Valley, got absorbed by SVTC, largely through the legal work that Hawes did on its behalf). It proved more difficult to bring environmental organizations into the coalition. Many were headed by managers of high tech firms, who did not view SVTC's union ties favorably. The environmental challenge was such, however, that several organizations including Greenpeace and the local chapter of the Sierra Club eventually collaborated with SVTC. Citizens for a Better Environment, a San Francisco-based environmental organization, also joined the coalition.[54]

Smith and Cervantes-Gautschi quickly inserted themselves into the debate on high tech pollution in Silicon Valley. The main issue at that time was the kind of storage rules that should be adopted to prevent future chemical leaks. Silicon Valley's fire chiefs, who were responsible for the storage of flammable materials, understood that the 1939 fire code requiring the burial of solvent tanks had been ineffective. In fact, it had partially contributed to the environmental debacle. New rules had to be devised. The fire chiefs called for new regulations and organized a task force to draft a hazardous materials model ordinance that could be passed by all city councils in Silicon Valley. The task force included firefighters and industry representatives, often the safety and environmental engineers of semiconductor firms.[55]

Smith and Cervantes-Gautschi won a seat at the negotiating table by launching an aggressive campaign pressing for tough rules on the storage of toxic chemicals. Like many others, Smith called for double containment of hazardous materials. In other words, the solvent tanks would have to be installed in a concrete

coffer that would prevent chemicals coming from the tanks to leak into the ground. Another rule, commonly agreed upon, was to monitor the tanks constantly by electronic means in order to detect leaks. But Smith and his labor allies also pressed for provisions protecting whistleblowers reporting environmental malfeasance from retaliation by their employers. He also demanded that corporations report which chemicals they used and stored to city governments.[56]

In 1983, Smith, Lamborn, and Cervantes-Gautschi organized an extensive campaign in support of these rules. Disabled electronics workers spoke at community meetings and conducted press interviews at contamination sites in favor of strict storage rules. For almost a year, thirty supporters canvassed neighborhoods located close to toxic spills to alert residents about chemical leaks and the dangers of semiconductor manufacturing. SCCOSH and the labor council also convened press conferences to pressure local politicians to vote for the ordinance, especially its whistleblower and right-to-know provisions that were strongly opposed by industry. In spite of this campaign, only the technical stipulations of the ordinance (tank monitoring and double containment for new chemical tanks) were passed by city councils in 1983 and into state law in 1984. The passage of the hazardous materials model ordinance was thus a half-success for SVTC and the Central Labor Council. But its campaign in support of the ordinance put Smith and his coalition on the map as a force to contend with in Silicon Valley.[57]

Making use of his newfound visibility and the contacts he had acquired through the storage ordinance campaign, Smith demanded that the cleanup of

Silicon Valley's aquifers be accelerated. Fairchild, for example, claimed that it might take up to ninety years to remove toxic chemicals from the San Jose water table. Finding this timeframe inacceptable, Smith called in the Federal government to take control of the cleanup effort and force Silicon Valley firms to speed up water decontamination. Hawes and Lamborn had used a similar tactic, when they had asked NIOSH to investigate safety lapses at AMD and Signetics in the late 1970s. In this case, it meant convincing the EPA to step in. In the spring and summer of 1984, SVTC convened large and emotional public meetings on the water crisis throughout the Valley. It also organized a petition drive asking the EPA to intervene.[58]

Responding to community pressure, in the fall of 1984 the EPA proposed to put nineteen Silicon Valley sites on its national priorities list, the so-called Superfunds (the list eventually grew to twenty-nine sites).[59] Among the Silicon Valley sites was of course Fairchild's plant in South San Jose. But there were also factories operated by almost every semiconductor corporation of note in the Valley: AMD, Fairchild, Intel, Intersil, Raytheon, Synertek, National Semiconductor, Monolithic Memories, and Teledyne Semiconductor. Fairchild and AMD had two sites on the list, and Intel three. The EPA listing established that Silicon Valley was one of the most polluted industrial regions in the United States (no other region had as many Superfund sites) and that semiconductor manufacturing was very far from being the clean industry it purported to be. This was a major public relations coup for SCCOSH and SVTC and a disaster for the semiconductor industry. With the EPA

came new rules and procedures that significantly limited the corporations' freedom of action. They had lost control of the cleanup effort.[60]

But success in mobilizing Valley residents and getting the EPA to place Silicon Valley sites on its Superfund list did not translate into union representation of high tech industry. Middle class residents, who had signed SVTC's petition and participated in meetings on water contamination, did not share the same interests and values as pro-union electronics workers. There was no community support, when the Glaziers Union attempted to organize Atari in 1983. The union suffered a devastating defeat, which called the strategy followed by SCCOSH and the council into question. The strategy suffered another setback when in 1985 Cervantes-Gautschi lost influence at the Central Labor Council. Conservative locals that had little interest in the environment and occupational health took over. Lamborn, the executive director of SCCOSH, resigned. These setbacks and repeated failures at organizing semiconductor firms persuaded SCCOSH to abandon its central goal of unionizing Silicon Valley. SCCOSH also splintered. The part that kept the SCCOSH name centered itself around educational programs and legal services for injured workers. SVTC left SCCOSH to become an independent organization that emphasized environmental and environmental justice issues. In the following years, SVTC acted as a corporate watchdog, following closely the implementation of the cleanup program mandated by the EPA. It battled industry on new fronts, air pollution and the management of toxic gases. In collaboration with SCCOSH, it also fought for reproductive justice and environmental justice.[61]

Conclusion

Silicon Valley was fertile ground for a major environmental and occupational health controversy in the late 1970s and 1980s. It had a very large industry that had contaminated many aquifers and severely affected the health of thousands of workers. But it is very likely that the full extent of pollution and workplace hazards would have never been known and addressed, had it not been for the drive, courage, and tenacity of a group of young women: Amanda Hawes, Patricia Lamborn, and Robin Baker of SCCOSH; Marta Rojas, Cathi Hee, and Cathy Bauerle of Signetics; Susan Yoachum of the *San Jose Mercury News*; and Lorraine Ross and her San Jose neighbors. They publicized the Signetics and water contamination scandals. They initiated lawsuits against Silicon Valley corporations. They put pressure on local authorities and the Federal government to intervene. One can speculate that without them, Ted Smith, and their allies at UE and the Central Labor Council, fire departments would not have obliged semiconductor firms to address safety and chemical storage issues. Local governments would not have passed toxic storage ordinances, and OSHA and EPA would have barely enforced Federal laws in Silicon Valley. Without them, the Valley might have remained the "clean" and "safe" place it used to be in the 1960s and 1970s.

A number of lessons can be drawn from this conflict over toxics in Silicon Valley. First, the sources of pollution were many. Massive use of toxic chemicals was

clearly essential for the Valley's environmental debacle. Another important factor was a mix of ignorance and corporate negligence. With the exception of IBM, at first Silicon Valley firms did not understand the dangers of many chemicals used in electronics manufacture. When they increasingly did in the 1970s, they made minimum investments in safety precautions. They dumped toxics into sewers and barely monitored tanks where they stored chemical waste. Regulations exacerbated workplace hazards and environmental pollution. Building codes required that semiconductor fabs look as un-factory-like as possible. This stipulation led to the formation of "chemical pools" on top of buildings and to the constant introduction of dangerous chemicals into the atmosphere of the cleanrooms through air intakes located on the roofs. Similarly, fire codes requiring the burial of chemical tanks had the unforeseen consequence of contaminating aquifers with hazardous substances.

Second, this story shows how difficult it was to organize the high tech industry in Silicon Valley. After many decades of unsuccessful unionization attempts, SCCOSH activists and their allies in the labor movement experimented with new approaches in the late 1970s and first half of the 1980s. They emphasized safety and health to mobilize electronics workers. They also used the water contamination scandal in order to overcome corporate resistance to unionization. In spite of considerable drive and ingenuity, they failed. This defeat can be partially explained by visceral opposition to unions among Silicon Valley executives, who were willing to make significant investments in safety and environmental remediation to fend them off. Another factor was the division in the labor movement

that prevented the formation of an alliance between UE and the AFL-CIO. Unions' lack of appeal among many microelectronics workers also played a major role in labor losses. Finally, the Silicon Valley middle class supported environmental cleanup, not unionization. The struggles of the late 1970s and 1980s, however, helped labor activists discover the potential of alliances with community groups to force recalcitrant corporations to accept unionization. Later, in the 1990s, Lamborn and other organizers put these lessons to work and unionized janitors and hotel workers with the support of Hispanic immigrant groups in San Jose.[62]

Third, unlike what is often assumed, industry was not homogeneous. While microelectronics corporations were united in their fight against SCCOSH, SVTC, UE, and the international unions, they approached work hazards and environmental pollution in different ways. Some firms, such as Intel and Signetics, were quick to respond to the environmental and occupational health crises. They set up effective safety and environmental engineering groups and gave a high priority to worker safety and environmental remediation. Others were slower in addressing these issues and did it less thoroughly. This was especially the case at Monolithic Memories. Significant differences in attitudes and approaches can also be detected within corporations. At least, three different groups can be identified, each one with its own values, functions, and interests: upper management, manufacturing managers, and industrial hygienists and environmental engineers. Manufacturing managers cared first and foremost about efficiency — raising yields and meeting deadlines. On the other hand, industrial hygienists took on the difficult task of making the cleanrooms

safer for workers and, at the same time, protecting their employers against lawsuits and governmental investigations. In the first half of the 1980s, manufacturing managers and safety engineers clashed repeatedly over these issues (it was upper management that often settled these disputes). In other words, conflicts were not only between corporations and anti-toxics activists. They also occurred within firms and internal struggles were nearly as intense as those between corporations and their labor critics.

Fourth, there was a labor origin to the anti-toxics movement in California. Anti-toxics organizing in Silicon Valley emerged out of a group of labor activists. Their denunciation of health hazards in semiconductor fabs contributed directly to the discovery of environmental pollution. They also publicized the water scandal and rallied communities in their drive to clean up the water table. The fact that the anti-toxics movement in the Valley was started and controlled by activists close to the left wing of the labor movement gave it a special character: it was highly confrontational, anti-management, anti-capitalist, and pro-union. But as much as the conflicts over toxics changed Silicon Valley industry, they transformed the activists themselves. Their inability to unionize the semiconductor industry and greater success on the environmental front led some activists to focus primarily on environmental justice issues and on environmental problems such as water cleanup and air pollution. Thus, the history of anti-toxics organizing in Silicon Valley is full of paradoxes: It started with a campaign to unionize the microelectronics industry and ended up initiating a massive, Federally-mandated environmental remediation program. Labor

activists turned into environmentalists and the organization that drove the movement splintered as it obtained its greatest success. Social activism is full of uncertainty indeed.[63]

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Abbreviations: DLP: Donald Liddie Papers, Computer History Museum; GMP: Glenna Matthews Papers, Special Collections and Archives, San Jose State University; GEMP: Gordon E. Moore Papers, Special Collections and University Archives, Stanford University; IBMFGWC: IBM and Fairchild Ground Water Contamination Reports and Correspondence, Research Library and Archives, History San Jose; PSCP: Pacific Studies Center Papers, courtesy of Lenny Siegel; SCCOSH/SVTC: SCCOSH/SVTC Papers, Special Collections and Archives, San Jose State University; SJMNCC: *San Jose Mercury News* clippings collection, Research Library and Archives, History San Jose.

[2] David Sanger, "Many Solvent Tank Leaks Found," in "Worries about Work Toxics Grow in Silicon Valley," *New York Times*, 10 November 1984.

[3] Robert Gottlieb, *Forcing the Spring: The Transformation of the American Environmental Movement*. Washington DC: Island Press, 2005; Gerald Markowitz and David Rosner, *Deceit and Denial: The Deadly Politics of Industrial Pollution*. Berkeley: University of California Press, 2013. See also Samuel Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955-1985*. Cambridge: Cambridge University Press, 1987.

[4] Another example of an environmental movement initiated by labor was OCAW's fight against industrial toxics in Louisiana's "cancer alley." See Markowitz and Rosner, *Deceit and Denial*.

[5] For accounts of the controversies on occupational health and environmental pollution in Silicon Valley, see Ted Smith, David Sonnenfeld, and David Pellow (eds.), *Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry*. Philadelphia: Temple University Press, 2006; Brian Mayer, *Blue-Green Coalitions: Fighting for Safe Workplaces and Healthy Communities.* Cornell: Cornell University Press, 2009; and David Pellow and Lisa Sun-Hee Park, *The Silicon Valley of Dreams: Environmental Injustice, Immigrant Workers, and the High-Tech Global Economy*. New York: New York University Press, 2002. See also Karen Hossfeld, "'Their Logic against Them': Contradictions in Sex, Race, and Class in Silicon Valley," in Kathryn Ward, ed., *Women Workers and Global Restructuring*. Ithaca: Institute for Labor Relations Press, 1990; Glenna Matthews, *Silicon Valley, Women, and the California Dream: Gender, Class, and Opportunity in the Twentieth Century*. Stanford: Stanford University Press, 2003; and Jason Heppler, "Machines in the Valley: Community, Urban Change, and Environmental Politics in Silicon Valley, 1945-1990," Ph.D. dissertation, University of Nebraska, 2016.

[6] Joseph LaDou, "The Not-So-Clean Business of Making Chips," *Technology Review*, 1984, 24-36. For a detailed listing of the dangerous substances used in the semiconductor industry,

see David Baldwin, Michael Williams, Andrew McIntyre, Patrick Murphy, and Lewis Scarpace, *Chemical Safety Handbook for the Semiconductor/Electronics Industry*. Boston: OEM Press, 1991.

[7] Oral communication from Jay Last, 19 August 2016. For Silicon Valley's history, see Christophe Lécuyer, *Making Silicon Valley: Innovation and the Growth of High Tech, 1930-1979*. Cambridge: MIT Press, 2006; Leslie Berlin, *The Man Behind the Microchip: Robert Noyce and the Invention of Silicon Valley*. New York: Oxford University Press, 2005; and Arnold Thackray, David C. Brock, and Rachel Jones, *Moore's Law: The Life of Gordon Moore, Silicon Valley's Quiet Revolutionary*. New York: Basic Books, 2015.

[8] For toxicological studies at IBM, see Joseph LaDou, oral history interview conducted by the author, 25 April 2006; Amanda Hawes, oral history interview conducted by the author, 8 February 2006; and Pellow and Park, *The Silicon Valley of Dreams*.

[9] An exception was Fairchild that employed safety engineers since 1960. Lee Neal, interview conducted by the author, 25 July 2015.

[10] Monthly issues of *Probe*, box 27, DLP; Susan Yoachum, "The Chemical Handlers," *San Jose Mercury News*, 6-8 April 1980.

[11] Joseph LaDou, "The Not-So-Clean Business of Making Chips," *Technology Review*, May-June 1984; Neal, interview; Timothy Rohm, oral history interview conducted by the author, 20 July 2015; Ed Sawicki, oral history interview conducted by the author, 22 August 2014; LaDou, interview.

[12] Don Liddie to J. Stokes, 5 October 1979; Liddie to Reese, 27 February 1980; Reese to Liddie, 21 April 1980 - all in box 1, DLP; Yoachum, "The Chemical Handlers;" LaDou, interview; Ted Smith, oral history interview conducted by Carl Wilmsen, 2000, Bancroft library, UC Berkeley.

[13] LaDou, interview; Hawes, interview. For the California Industrial Medical Clinic, see Lamborn, interview; Lamborn, proposal for the Skaggs Foundation, 29 August 1983; Lamborn, report to CHD September 1983-August 1984; Lamborn, report to the board, 24 January 1986 – all in box 8, SSCOSH/SVTC; Bob Goligoski, "Workers Protest at Clinic," *San Jose Mercury News*, 12 November 1983.

[14] Adam Olivieri et al., "Ground Water Contamination in Silicon Valley," *Journal of Water Resources Planning and Management*, volume 3, July 1985; Smith, interview; Hawes, interview; Neal, interview; Lewis Scarpace, oral history interview conducted by the author, 14 July 2015.

[15] Testimony of Hugh Short, in ECOSH to Gerald O'Hara, 9 September 1980, box 5, SCCOSH/SVTC. For the disposal of hazardous chemicals, see Oliveri et al. "Ground Water Contamination in Silicon Valley;" Don Keller, "Poison-Dumping in County Called 'Serious'," *San Jose Mercury News*, 3 April 1976, 20A; Gordon Moore, oral history interview conducted by the author, 25 March 1997.

[16] Memorandum for the process council, 24 January 1980 and Liddie, "Organization Announcement," 12 March 1980, both in box 1, DLP; Neal, interview; Sawicki, interview; see also *Probe* articles: "All about Safety," May 1975; "Safety First," May 1976; "New Safety Committee Set," March 1977; and "Chemical Safety," April 1978 - all in box 27, DLP.

[17] Hawes, interview; Patricia Lamborn, oral history interview conducted by Glenna Matthews, no date, GMP. For UE organizing in Silicon Valley, see David Bacon, "Land of the Open Shop: The Long Struggle to Organize in Silicon Valley," *New Labor Forum*, 20 (1), 73-80,

2011; Bacon, "Roots of Social Justice Organizing in Silicon Valley," 2015; and Matthews, *Silicon Valley, Women, and the California Dream*.

[18] Bacon, "Land of the Open Shop;" Lamborn, interview; Hawes, interview; Lenny Siegel, oral communication, 17 August 2016.

[19] Lécuyer, *Making Silicon Valley*; Bacon, "Land of the Open Shop;" Lamborn, interview; Hawes, interview. For a discussion of employee-management relations in Silicon Valley, see Lécuyer, "High Tech Corporatism: Management-Employee Relations in U.S. Electronics Firms, 1920s-1960s," *Enterprise and Society*, 4 (2003), 502-520.

[20] *Organize*, November 1976 and 13 April 1977, unions folder, PSCP; Dave Goggins, "Valley Women Focus of Industry-Cancer Pilot Study," *San Jose Mercury News*, 7 September 1977; Lamborn, interview; Hawes, interview; David Bacon, interview conducted by the author, 24 February 2016.

[21] SCCOSH incorporation papers, 18 August 1979, box 8, SCCOSH/SVTC; Lamborn, interview; Hawes, interview. For the COSH movement, see Gottlieb, *Forcing the Spring*; and Daniel Berman, "Grassroots Coalitions on Health and Safety: The COSH Groups," *Labor Studies Journal*, Spring 1981, 104-113.

[22] Hawes, interview; Lamborn, interview.

[23] Lamborn, "SCCOSH proposal narrative 1983-1984" for the Campaign for Human Development, Archdiocese of San Francisco (no date), box 8, SCCOSH/SVTC. This statement, phrased slightly differently, can be found in Lamborn, "Proposal narrative, 1983-1984," sent to the Skaggs Foundation on 29 August 1983, box 8, SCCOSH/SVTC.

[24] Lamborn, Proposal, 1982, box 8, SCCOSH/SVTC; Paul Voakes, "It's Good Business to be a Safe Place for Workers," *Times Tribune*, 4 May 1979; Lamborn, interview; Bacon, interview.

[25] ECOSH to Gerald O'Hara, 9 September 1980, box 5, SCCOSH/SVTC; Lamborn, proposal, 1982; and Lamborn, proposal to the Skaggs Foundation, 1983 - both in box 8, SCCOSH/SVTC; Bacon, interview.

[26] *ECOSH News*, April 1979, SCCOSH folder, PSCP; Liddie to Reese, 27 February 1980, box 1, DLP; Yoachum, "The Chemical Handlers;" Hawes, interview; Lamborn, interview.

[27] *ECOSH News*, April 1979; Liddie, "NIOSH preparation meeting," 18 April 1980, box 1, DLP; Yoachum, "The Chemical Handlers;" Hawes, interview; Lamborn, interview; Donald Liddie, oral history interview conducted by the author, 6 December 2001.

[28] Lamborn, proposal, 1982; Lamborn, proposal to the Skaggs Foundation, 1983; Lamborn, proposal to CHD, 1984; Liddie, "Three additional complaints to NIOSH," 30 April 1980 – all in box 8, DLP; Lamborn, interview; Hawes, interview.

[29] Mike Myslinski, "Signetics Making Progress on Fire Safety Violations," *Sunnyvale Scribe*, 31 October 1979; Liddie to Harwood, 18 February 1980; Vaden to Liddie, 4 February 1981; B. Robinson, "Sunnyvale Eases Restrictions on Industrial Development," 5 September 1983, in box 1, DLP; Neal, interview.

[30] "SIA Announces Occupational Health System Program for the Industry," *SIA Circuit*, August 1981; Barbara Buell, "SIA-commissioned study calls industry relatively safe," *The Peninsula Times Tribune*, 2 October 1981; Hawes, "Job Illness Cover-up,"1983; Cal-OSHA to OSHA statistics, 20 July 1983; Cal-OSHA, "News Release," 18 August 1983; David Sanger, "Worries over Toxins Grow in Silicon Valley;" KRON-TV, "News Release," 27 May 1985 - all in PSCP.

[31] Yoachum, "The Chemical Handlers;" Hawes, interview; Lamborn, interview ; Sawicki, interview; Neal, interview; Rohm, interview; Scarpace, interview.

[32] Liddie to Halter, 5 February 1981, box 3, DLP.

[33] Intel devoted one million dollars to its safety programs in 1980. See "Albuquerque Notes," April 1980, GEMP.
[34] Sawicki, interview; Neal, interview; Rohm, interview; Scarpace, interview.
[35] Liddie to Halter, 5 February 1981, box 3, DLP; Sawicki, interview; Neal, interview; Rohm, interview; Scarpace, interview ; Yoachum, "The Chemical Handlers."
[36] Ray Vaden, "State-of-the-Art Air Monitoring System Installed," *Probe*, November 1980; Rohm, "Safety Corner," *Probe*, January 1981 and February 1981; "Playing it Safe: The Little-Known Story of Signetics' Big Win," *Probe*, October 1985, all in box 27, DLP. See also Neal, interview; Rohm, interview; Scarpace, interview.
[37] Yoachum, "The Chemical Handlers."
[38] Sawicki, interview; Neal, interview.
[39] Ray Vaden to Liddie, 4 February 1981; Liddie to Chuck Harwood, 14 January 1983; Liddie to Harwood, 7 March 1984, all in box 1, DLP; *Union Voice*, July 1982, August 1982, and October 1982, unions folder, PSCP; Sawicki, interview; Rohm, interview; Neal, interview; Bacon, interview.
[40] For the Fairchild leak, see James Levine, office memorandum, 9 December 1981, 1981 correspondence binder, Fairchild Camera series, IBMFGWC; Betty Roeder to Ralph Trefney, 22 January 1982, 1982 correspondence binder, Fairchild Camera series, IBMFGWC; Neal, interview.
[41] Levine, memorandum; Smith, interview.
[42] "Water Supply Suspected in Silicon Valley Birth Defects," *San Mateo Times*, 4 February 1982; "San Jose Search is Pressed on Birth Defects, Chemical Leak," *Oakland Tribune*, 5 February 1982; Smith, interview.
[43] For example, see Yoachum, "A mother's worries on plant leaks," 16 March 1982; "More wells to be tested for chemicals," 17 March 1982; "Fairchild's neighbors take toxic-leak case to council," 18 March 1982; "Electronics firm's drinking water tainted," 26 March 1982; "City's reply to contamination questions criticized," 31 March 1982 - all in SJMNCC; Smith, interview.
[44] Claims against the Regional Water Resources Control Board, 29 April 1982, 1982 correspondence binder, Fairchild Camera series, IBMFGWC; Mitchell Benson, "Pact Reached in Tainted Water Dispute," *San Jose Mercury News*, 4 July 1986; Hawes, interview; Smith, interview; Lamborn, interview.
[45] Liddie to Selditch, 3 February 1982; Liddie to all managers, 23 February, 1982; Liddie to all managers, 23 March 1982; Liddie to Harwood, 14 January 1983 – all in box 1, DLP; Yoachum, "Water Tests Will Begin Next Week," *San Jose Mercury News*, 24 March 1982; Sawicki, interview; Smith, interview.
[46] Olivieri et al., "Ground Water Contamination in Silicon Valley;" Sawicki, interview.
[47] T. J. Rodgers cited in Tekla Perry, "Coming Clean," *IEEE Spectrum*, February 1993.
[48] Signetics organization chart, 1983, box 17, DLP; Neal, interview; Sawicki, interview. Starting in the spring of 1984, Gordon Moore funded the Nature Conservancy. He later became a major patron of Conservation International, a pro-business environmental organization. Silicon Valley firms such as Signetics also donated funds to environmental groups in the mid-1980s.
[49] Mitchell Benson, "Settlement No Cure-all for Residents," *San Jose Mercury News*, 4 July 1986; Nelson Stone, oral history interview conducted by the author, 25 November 1995; Neal, interview; Sawicki, interview.

[50] Lamborn, "Year-long summary, Sept. 1983-Aug. 1984" (no date, probably August or September 1984) prepared for the Campaign for Human Development, SCCOSH/SVTC, box 8.
[51] Lamborn, proposal to the Skaggs Foundation, 1983; Lamborn, proposal to CHD for 1983-1984; Lamborn, report to CHD for 1983-1984; SCCOSH planning retreat, 1985 – all in box 8, SCCOSH/SVTC; Hawes, interview; Lamborn, interview; Smith, interview.
[52] Lamborn, "Narrative" (1982), in box 8, SCCOSH/SVTC.
[53] Lamborn, proposal to the Skaggs Foundation, 1983; Lamborn, proposal to CHD for 1983-1984; Lamborn, report to CHD for 1983-1984; Yoachum, "Why electronics workers haven't joined unions," *San Jose Mercury News*, 6 September 1982, in SJMCC; Lowell Truner and Daniel Cornfield, *Labor in New Urban Battlegrounds: Local Solidarity in the Global Economy*. Cornell: Cornell University Press, 2007.
[54] Lamborn, proposal to the Skaggs Foundation, 1983; Lamborn, proposal to CHD for 1983-1984; Lamborn, report to CHD for 1983-1984; Smith, interview.
[55] Lenny Siegel and John Markoff, *The High Cost of High Tech: The Dark Side of the Chip*. New York: Harper & Row, 1985; Smith, interview; Neal, interview; Sawicki, interview.
[56] Lamborn, proposal to the Skaggs Foundation; Lamborn, report to CHD for 1983-1984; Smith, interview.
[57] Lamborn, proposal to the Skaggs Foundation; Lamborn, report to CHD for 1983-1984; "News Release of the Central Labor Council of Santa Clara County," 23 February 1983, unions folder, PSCP; Smith, interview.
[58] Smith, interview.
[59] The great majority of these sites were added to the EPA's final list between 1986 and 1989.
[60] Smith, interview.
[61] Lamborn, "Report to the Board," 24 January 1986; SCCOSH minutes, 2 April, 14 May, and 11 June 1986; SCCOSH retreat, 18-19 October 1986 – all in box 8, SCCOSH/SVTC. For conflicts within the Central Labor Council, see Truner and Cornfield, *Labor in New Urban Battlegrounds*.
[62] For the lessons drawn from the struggles of the late 1970s and first half of the 1980s, see Bacon, "Land of the Open Shop."
[63] For the growing distance between SVTC and labor in the 1990s, see Mayer, *Blue-Green Coalitions*.