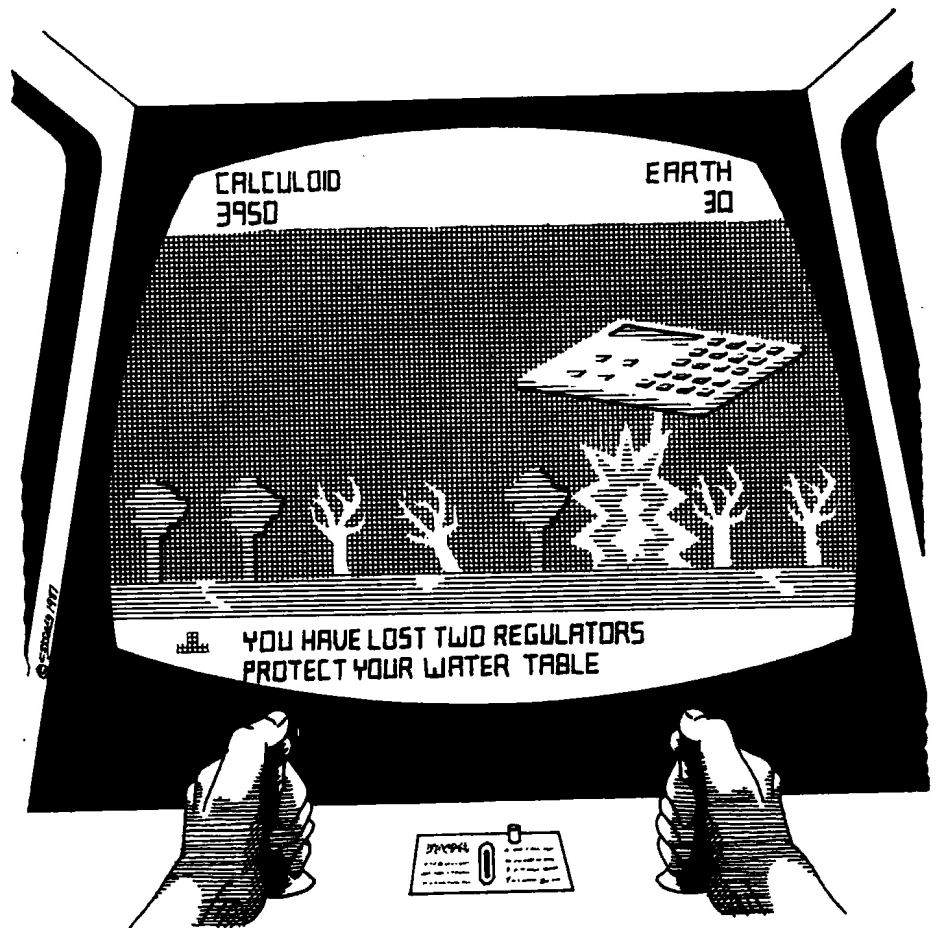


The hazards of high tech

Lenny Siegel and
John Markoff



Pocket calculators. These days everybody seems to have at least one. In fact, some people are never seen without one of the small devices—about the size of a credit card. Even kids have them, sometimes in cute animal shapes.

As commonplace as the whole panoply of products of the microelectronics revolution are (they run the gamut from watches to weapons), it's hard to remember that not too long ago, they were science fiction, not fact. In the 1950s, there were only about 1,000 computers and no microprocessors, the tiny silicon chips that are the brains of new computers, in the United States. By 1976, 220,000 computers and three-quarters of a million microprocessors had been produced. By 1980, the United States was using more than

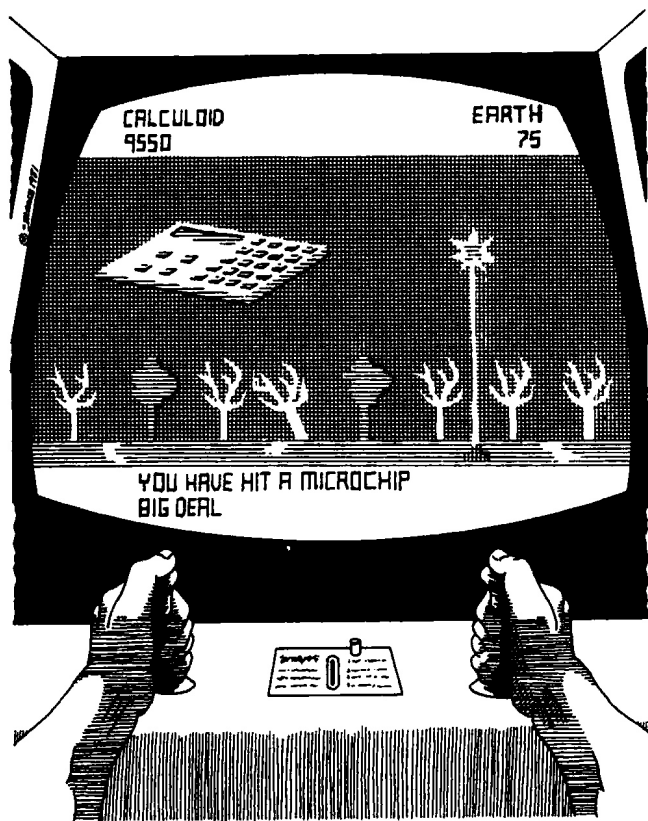
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10 million microprocessors, those seemingly magical devices with amazing powers of memory and blinding computational speed.

Silicon chips and the products they're used in have appeared virtually overnight in a world which knows little about how they are made and what they can do—and a world that knows even less about what the environmental effects of manufacturing them are.

Meanwhile, local and state officials from all over visit California's Silicon Valley—the center of the industry and the Eldorado of reindustrialization—to try to lure the high tech companies to their cities and states. From the southwest corner of the San Francisco Bay area, they bring back tales of a clean, light industry that provides jobs, pays taxes and does wonders for a community's image.

But it may not be so clean. Electronics today is largely a chemical process in which highly toxic substances are used



and toxic wastes are created. Any community that longs to become the next Silicon Mountain, Silicon Mesa or Silicon Strip should be aware of the problems those chemicals can create.

The brain of that now ordinary pocket calculator begins its life as a tiny square etched into the surface of a thin disc of silicon four inches in diameter. Each square is a complex electronic circuit, but literally hundreds of them can fit onto each silicon disc, or "wafer." After the circuitry is photographically etched, the wafer is broken apart into individual "chips." These are then shipped to Asia, where low paid women attach microscopic strands of gold wire connecting the chips to individual holders. At this point, the product looks something like an inch-long caterpillar with 12 to 48 pairs of legs. Finally, the holders are plugged into printed circuit boards, along with resistors, capacitors, light emitting diodes and switches. The tiny device can now perform arithmetic marvels.

Generally, the process used in making the pocket calculator is repeated in hundreds of other electronics products, commonplace and unusual. Holders of chips are plugged into a board with many other chips. A full-sized computer may have 20 to 100 printed circuit boards, each holding literally thousands of integrated circuits, or chips.

Throughout this process, chemicals are used—chemicals which are beginning to turn up in alarming places in the Silicon Valley.

- Residents of a mobile home park in Sunnyvale, across the street from an electronics plant, have experienced increased incidences of liver and kidney problems, possibly due to emissions of toluene and a variety of ketones, which are used as cleaning solvents.

- Fairchild Semiconductor paid to clean up—but never admitted responsibility for—the spill of a highly alkaline substance into Stevens Creek, which extends through the Silicon Valley to San Francisco Bay.

- Santa Clara Metal Refining Co., which does recycling for several electronics firms, dumped sodium cyanide, a toxic salt, in its driveway, largely, it claims, because the substance was mislabeled.

- Small amounts of trichloroethylene (TCE), a solvent suspected of causing cancer, have been found in area wells, although local officials claim the level does not now pose a risk.

- Each week, a single electronics plant can produce a truckload of chemical wastes. Even when they're carted away to legal dumps, there is reason for concern. Bob Wenzlau, an environmental engineer and member of the Solid Waste Management Planning Committee of Santa Clara County (which just about is Silicon Valley), says, "Most of these substances don't break down. We're creating a waste management problem which may last for generations."

- And some toxics have been dumped illegally. A San Jose lawyer says he's spoken to half a dozen industry workers who admit having literally poured dangerous chemicals down the drain, and there have been spills into the area's storm drainage systems as well.

The chip was developed simultaneously at Fairchild Semiconductor in Mountain View, Calif. and Texas Instruments in Dallas about 20 years ago. Obviously sensing the new industry's potential, so many executives and engineers left Fairchild to form their own firms that by 1971, the surrounding area was dubbed Silicon Valley.

Today, five of the top eight U.S. based marketers of integrated circuits are based in Silicon Valley: Fairchild and its offshoots—National Semiconductor, Intel, Signetics and Advanced Micro Devices. And every kind of electronics device is manufactured in the valley—computer games, medical equipment, military systems. For example, some of the country's largest makers of small and personal computers—Apple, Atari and Hewlett-Packard—are based there.

But the high tech boom is going on in other places as well. Enclaves of chip users and producers are scattered all around the country, from Aloha, Ore. to Colorado Springs to the Boston area's Route 128 complex. Texas Instruments is actually still the largest chip seller. Also in the top eight are Phoenix based Motorola Semiconductor and Mostek, a spin-off of Texas Instruments, also based in Texas.

Most major semiconductor houses are now owned, wholly

