EXCERPT

Infinite Loop

How the World's Most Insanely Great Computer Company Went Insane

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Currency

Read the Review

Can any poet re-create
a worthy portrait of the great?
--Horace, Odes 1:6

1.0 ROOTS

Before and after everything, companies are about character.

Before the first idea, the first money, the first employees, the first distributor, retailer and customer, before the creation of the company itself, there is the character of the founders. Their ambition, talent, creativity and will to succeed are what make them successful entrepreneurs and distinguish them from the millions of people who only dream of creating their own company. Character also distinguishes these rare individuals from the thousands who try to create their own companies but are defeated by the market, competition, bad luck and an unwillingness to do whatever it takes to win.

After the company has grown rich and safe and mature, character tells as well. After the founders have left or died, after the excitement has moved elsewhere along with the best employees, after the company's products and logo and image have grown synonymous with staid and predictable. After hot new firms have appeared on the scene, start-ups that most resemble the company of old, and begin to carve away great chunks of the market. Then once more it is character, in the company's institutional memory, its community and in the philosophy with which the founders imbued it, that may spell the difference between another generation of success, or a slow, ugly corporate death.

Good companies have strong characters. Great companies have heroic characters. The greatest companies of the twentieth century all had extraordinary characters: Royal Dutch Shell, De Beers, Ford, General Motors, IBM, Hewlett-Packard, General Electric, Intel, Microsoft. They weren't necessarily "good" characters. One need

only think of De Beers and Shell and their rape of underdeveloped nations, Ford and its crushing of workers early in this century, Microsoft and its alleged monopolistic destruction of the software industry. But they were bold, fearless and consistent. And it was this inner strength that enabled these companies not only to win their early competitive battles but to survive wounds that would (and did) kill their lesser counterparts.

Ford, battered first by GM, and then by the Japanese in the 1980s, struggled and regained its leadership in the 1990s with a new family of brilliantly innovative cars. IBM suffered one of the worst business collapses in the century at the end of the 1980s, then restored itself in just five years. HP slid into complacency and inertia, then somehow righted itself in the 1990s to become the most innovative large company on the planet. During this same period, Microsoft missed the most important technological revolution of the era, the Internet, then accomplished a breathtaking turnabout and gained the leadership of that industry.

Of all the great companies of recent memory, there is only one that seemed to have *no* character, but only an attitude, a style, a collection of mannerisms. It constructed a brilliant simulacrum of character, in the way a man without empathy or conscience can pretend to have those traits. But it was never really there--even though two generations of employees convinced themselves otherwise. It was only when that character was finally tested did the essential hollowness of the enterprise finally stand exposed, and the employees and customers shrieked with betrayal.

This was Apple Computer Inc., and there has never been a company like it. It was founded by two young men, one a genius with no allegiance to any institution but his own mind; the other a protean, inconstant figure who seemed composed of nothing but charm and a pure will to power. The company they built seemed to have everything: great technology, superb products, talented employees, rabidly loyal customers, an arresting vision, even a lock on the zeitgeist. But, like its founders, it lacked character. And because of that, from the first minute of the first meeting of Steve Jobs and Steve Wozniak, a decade before the company's founding, Apple Computer was set on a path from which it could not escape, even after those founders were gone. And that path would in time lead to the company's destruction.

More than any other great company, the seeds of Apple's future glory and its subsequent humiliation were planted long before the company ever began. And bend and prune as it might, Apple Computer could never free itself of its roots.

2.0 SEED

It was Regis McKenna, the Silicon Valley marketing guru, who first saw the horrible truth: "The mistake everyone makes is assuming

that Apple is a real company. But it is not. It never has been."

He was too much of a businessman (after all, Apple could prove to be a once and future client) to draw the final inference: "And it never will be."

Nobody alive knew Apple better than Regis McKenna--at least nobody who had been affected by the notorious "reality distortion field" that emanated from Steve Jobs;. After fifteen years of handling the company, Regis had remained unwarped and unconverted because no matter how successful Regis McKenna Inc. had become, and no matter how far it had left the publicity game behind for the more rarefied climes of marketing and business development, Regis still remained a PR man at heart. He still upheld the flack's first law: never, ever believe the hot air you put out about your client.

Not that it was easy. When you watched your client land on the cover of *Time* magazine and knew you got the credit for getting him there; when you stood in the convention centers and giant auditoriums and felt the waves of adoration rolling around you; and when the calls came late at night and you heard Jobs the Seducer telling you how much he depended upon you, it would have been so simple to surrender to the undertow, to lose yourself in the Apple Will.

But every time Regis thought of doing so there would be a meeting to remind him that Apple was a kind of collective madness. He would bring in an expert on marketing, or branding, or organizational theory--anything that might give the company some order, some strategic planning, some simulation of real business discipline--and he would watch in dismay as that person was humiliated, ignored or driven away. As for his own advice--well, nobody blew off the mighty Regis McKenna. Instead, they'd listen intently, nodding, foreheads pinched in concentration, even the seraphic Jobs himself making those unreadable and delicate motions with his fingers on the tabletop as if he was taking seriously what Regis was saying ... and then the Apple Corps would leave the room and never think about Regis's message again.

In the end, after fifteen years advising the company he'd helped to create, McKenna walked away from Apple Computer. And not just from Apple, but from PR itself. Henceforth, the most successful publicist in the history of high technology would dedicate his firm to marketing. "It got to be my cross to bear," he said, looking back at the story of Apple Computer. "I helped create much of the image of Apple. Then I realized that I could help make people famous and have them assume the mantle of greatness, but that I couldn't do anything about the reality behind the story--the flaws and the insecurities and the egos. It just got to the point where I couldn't do it anymore. If it wasn't real, I didn't want to construct it."

So McKenna understood first. And in the years that followed, others, typically after they left the Cupertino kindergarten, caught on as well. Yet what they had learned was somehow inexplicable. It was like coming out of a coma and trying to describe where you've

been. Some were bitter, a few amused, most just dazed in a way that could never be brought to focus. Even Regis, a man who had become rich and famous explaining technology and the companies that built it, would hit a wall when describing Apple. After twenty years, he could tell you what Apple was not, but he was at a loss for words telling you what it was. The best he could come up with was "a corporate Woodstock"--which explained everything, and nothing.

Others tried. Michael Moritz, who in 1984 wrote the first and best-known book about Apple, entitled it *The Little Kingdom*, suggesting at once the attractive preciousness of the place, its essential unreality, and the imperial nature of its organization. A few years later, Steven Levy, in his book about the Macintosh, would choose a memorable Jobs phrase, *Insanely Great*, that captured in its near-oxymoronic form two essential characteristics of the company. The pseudonymous Robert X. Cringely, in his entertaining (if suspect) *Accidental Empires*, compared Apple to an episode of *Bonanza*, the Bagwan's Rancho Rajneesh in Oregon and even the suicidal Jonestown.

Yet none of these descriptions, witty as they were, were sufficient to capture the true nature of Apple. It was only later, as the deep undercurrents in the company finally broke the surface that it became apparent that Apple Computer was, in fact, a beautifully constructed story, an elaborate fiction that mixed comedy with tragedy, piled irony upon irony, and then finally, bizarrely, looped back on itself.

And once that became clear, so did the author. Steve Jobs. The truth had always been there in Jobs's knowing little smile.

There are thousands of successful entrepreneurs at work right now, from Bill Gates to the men and women meeting right now with a start-up team at Denny's, and none of them have written a tale as soaring and arresting as that of Apple. Perhaps no company in history has ever provoked such intense interest, loyalty, love and hate. For the richness of the plot, for the endless dramas, for the sheer *aesthetics* of its story, Apple is unique.

Trip Hawkins, himself an important entrepreneur, and a former Apple manager of market planning, told Cringely, "Steve never knew his parents. He makes so much noise in life, he cries so loud about everything, that I keep thinking he feels that if he just cries loud enough, his real parents will hear and know that they made a mistake giving him up."

That cry was Steve Jobs's hidden goad. With it alone he might have become a poet like his natural sister, or, quite easily, given the pathological parts of his personality, gone into crime--which, in fact, for a short time he did. His great luck was to find himself on the perfect playground for his gifts: the world of Silicon Valley in the 1970s.

2.0.1 Collision

Silicon Valley in 1965, at the time when Steve Jobs was attending Monte Loma elementary school in Mountain View, was a tense combination of opposing demographic forces.

Strictly speaking, Silicon Valley didn't yet exist. Sure, Fairchild was there, but it became mythic only in retrospect. If you were to drive down Ellis Street in Mountain View past its headquarters you never would have known that this little company was already changing the world.

Hewlett-Packard, of course, was there. By 1965 it was already more than twenty-five years old. At night, driving up El Camino Real in Palo Alto heading to the young Stanford Shopping Center, you could see its sawtooth roof glowing atop the hill up Page Mill Road. But HP was, and is, as hermetic as a church. If your father worked there, you were embraced within the HP family, you met Bill and Dave and attended the company picnic, and lived in an Eichler home in Palo Alto. Your neighbors were college professors from Stanford, other HPers or engineers and scientists who worked near HP in the Stanford Industrial Park at companies like Varian Corp., Watkins Johnson or Syntex.

But more important than HP was Lockheed Missiles & Space (LMSC), a city in itself rising alongside the Bay next to the Moffett Naval Air Station and NASA's Ames Research Center. Each day at 7 A.M., Lockheed's 25,000 employees would leave their homes in Mountain View, Sunnyvale, Cupertino and Santa Clara--from housing developments that had been built specifically for them by smart developers--and crowded the streets heading east into the morning sun toward the two LMSC gates. And each day at 3:30 P.M., the process would reverse, giving the Valley a distinct work cycle that would dominate the area for twenty years.

More than any other force, Lockheed was the dynamo that made Santa Clara County (the western cities of the South San Francisco Bay from Palo Alto to San Jose) the fastest-growing place in America. Young men, new families in tow, arrived by the scores each day, armed with a GI Bill degree in aeronautical, electrical or mechanical engineering, and looking for a piece of the aerospace future. They bought their ranch-style house--or, if they were adventurous, a Bauhaus-for-everyman Eichler with an atrium--and drove off every morning to build ICBMs for Lockheed.

Those who now call that world stultifying, conformist or retrograde weren't there. It was, in fact, as progressive in its way as any place on earth. The men and women who populated Silicon Valley in the 1960s were optimists. They believed that they were not only constructing the future but creating a perfect world for themselves and their families in the process. They would be famous and rich, have beautiful children and live in a Winterless Paradise and own a modernistic house and collect fine wines--all at the same time.

The betrayal, the depression and the self-doubt only came later, after Lockheed laid off at least one breadwinner on every residential block, after their kids grew their hair long and despised them and, worst of all, after these young men and women of infinite promise became divorced, career-stalled middle-aged men and women with a ceiling on their hopes.

It came after the counterculture revolution, Vietnam and recession, and after Silicon Valley had become a single monolithic urban stretch of high-tech communities thirty miles long and ten miles wide. In 1965, though, these professional communities were still tiny enclaves of (mostly) white, (mostly) Protestant, (mostly) engineers embedded in vast stretches of old Santa Clara Valley: blue-collar, rural, orchard-based, seasonal, immigrant, Catholic.

Mountain View was one of the oldest of Valley communities. Originally the Castro family land grant from Mexico, it was a well-developed farming community by the beginning of the twentieth century. The children and grandchildren of these farmworkers were enjoying the postwar prosperity by moving up to the new suburban housing developments, like the square mile of ersatz Eichlers built by Mackay Homes on the edge of Mountain View along Alma and San Antonio roads hard by the southern tip of Palo Alto.

For the local families that moved into this development in the early 1960s, these homes were the culmination of an assimilationist dream that in some cases reached back a century. It was the family's first toehold in the middle class, thanks to new jobs in auto repair shops, assembly lines and retail stores. Yet they soon found their shiny dreams tarnished by the arrival of new neighbors from the East Coast or the Midwest; arrivistes who drove their foreign cars every Friday night to San Francisco in search of real culture, and who owned not just college diplomas but graduate degrees in unimaginable disciplines like solid-state physics and semiconductor electronics.

For these newcomers, the neighborhood was not a culmination but a flagstone on the path to bigger houses in nicer neighborhoods in Sunnyvale or Cupertino, and then, with luck and some stock options, Los Altos Hills or Saratoga. For now, they merely demanded that the schools improve their facilities, that local stores offer more diverse merchandise and that the constabulary protect their children from the predations of the tougher working- class kids down the street.

It was a situation guaranteed to provoke friction and hostility. The upwardly mobile new Silicon Valleyites saw the natives as uneducated, unsophisticated and slightly dangerous, and the old Santa Clara Valleyites saw the newcomers as arrogant, pushy and, worst of all, a threat to their hard-fought prosperity.

2.1 Mockingbird

It was in this tense milieu that nine-year-old Steven P. Jobs found himself in 1965. And within this sensitive and often irritating boy the schisms went even deeper.

His father, Paul Jobs, grew up on a farm in Germantown, Wisconsin, dropped out of high school, then knocked around the Midwest in search of work. After Pearl Harbor he made the odd decision, for someone at the landlocked center of the country, to join the Coast Guard. As the war ended, he found himself in San Francisco on a decommissioning ship, and in yet another one of the compulsive moves that would characterize his life, Jobs bet a shipmate that on one of their upcoming leaves he would find himself a wife.

He did just that, on a blind date. Feckless he might be, but Paul Jobs was also a persuasive man; a natural salesman. Unfortunately, he had one disastrous flaw for a salesman. He hated kowtowing to customers. He talked his new wife, Clara, into moving back with him to the Midwest, a decision that ran precisely counter to the great migration of ex-GIs. Needless to say, it was a bad strategy, and after struggling as a machinist and then a used-car salesman, Paul finally, in 1952, caught on to the spirit of the era and he and Clara headed back to San Francisco.

Despite the fact that California wasn't as golden as he expected, and Paul jumped from one lousy job to another--bad-debt collector, car repossessor, loan checker--he and Clara were now feeling suitably stable and settled to start a family. In 1956, they adopted a baby boy, Steven. Five months later, before the adoption legalities were even complete, the family moved to South San Francisco.

There was in Paul Jobs an unusual, though not rare, combination of romanticism, unreality, hard work, ego and self-doubt. He was, in a sense, an entrepreneur who missed his calling, a lone wolf who chafed in every organization in which he worked, who resented being subordinate to anyone, who felt he was destined for important things but always arrived at the station just as the train pulled away, and who was perpetually ashamed about his lack of success. No sooner did he construct a new hopeful reality than it would crash around him and he would set off again.

In 1960, the finance company Paul was working for transferred him to Palo Alto. It was a good place for a man approaching middle age. The economy was booming and jobs were waiting unfilled. As they moved into their new home in Mountain View, it seemed that Paul Jobs had finally made it. Marking this new phase in their lives, Paul and Clara adopted a daughter, Patricia.

Now the Jobs family was in the very embodiment of a Postwar Upward Mobile community. It was as diverse a neighborhood as any the Valley would ever know. On a single block one might find a psychiatrist working at Agnews State Mental Hospital, a high school janitor, a naval officer flying P-3 sub chasers out of Moffett Field, a gardener from the Philippines who worked for the city, a Pakistani PhD in geology analyzing moon rills at NASA-Ames Research

Center and a computer scientist who would one day be a vice president of Hewlett-Packard.

In the midst of all this was a brilliant little boy, often distracted, something of a discipline problem and accustomed to being the center of attention. He was the inevitable star of neighborhood home movies, birthday parties and picnics. Not only was young Steven doted upon by his parents but as the years went on he increasingly became the surrogate for his father's frustrated career desires.

The result would likely have been an arrogant chronic overachiever, the kind of obnoxious personality type that fills the senior, but not top, management ranks of Silicon Valley. But there were two other factors at work as well. One was that young Steven, the adopted child, was simply *different* from his family. Where his old man was tough and gregarious, the kind of guy who could repossess cars all week, then spend the weekend rooting around junkyards for parts for the classic cars he rebuilt in his garage, his son was sensitive and withdrawn. The boy was a discipline problem at school, while still managing to have few friends. He would go with his dad to the junkyards, obviously enjoying the dickering, but once they returned home he showed no interest in getting his hands dirty bolting on carburetors and fenders.

Worse, Steven was also a whiner. When he took swim lessons at the Mountain View Dolphins Swim club, one of his classmates, Mark Wozniak (yet more evidence that Silicon Valley has always been a very large small town) would recall: "He was pretty much of a crybaby. He'd lose a race and go off and cry. He didn't quite fit in with everybody else. He wasn't one of the guys." In fact, he was one of the boys, found in every class, who get the stuffing knocked out of them on a regular basis.

Out of place at home and at school, Steven turned to others in the neighborhood for friendship. It was possible in those days to walk down the street on a Saturday morning, past all the open, well-stuffed one-car garages and see the neighborhood men at work on their hobbies. And these extracurricular activities were as diverse as their careers. For every two Paul Jobses installing new lifters on engines there was at least one man surrounded by used oscilloscopes, multimeters, waveform generators, oscillators and all the other detritus of the vacuum-tube age of electronic instruments. Many of these obsolete devices had been lifted out of Dumpsters at the office and were now being put to use on televisions, stereos and, identified by the telltale antenna masts swaying over the house, ham radios.

Steven had just such a neighbor, a Hewlett-Packard engineer. One Saturday, while the boy was desultorily working with his father on a car, this engineer hauled a carbon microphone, a battery and an old stereo speaker out on the driveway, hooked them up and shook the street. Steven's eyes lit up. How does that work? he asked his father. Paul Jobs shrugged. He didn't know. So Steven ran to the engineer's house to ask. From then on, almost every Saturday, Steven stood in a new garage, peppering his new role model with questions.

His son's attention wasn't the only thing Paul Jobs lost. His job, he was convinced, was going nowhere. It didn't help that one by one the professionals among his neighbors began to move away to smarter, more expensive neighborhoods in Palo Alto and Los Altos. Unhappy and desperate, Paul Jobs decided once again to make a career shift. He took courses in his off-time and earned his realtor's license.

It was, in fact, a brilliant move. With the economy surging, the cost of living starting to climb, and one more old cherry orchard being covered by a new housing tract almost by the week, real estate was one of the most lucrative professions in the Valley. Had he stuck with it, Paul Jobs, like many others, might have made himself wealthy over the next twenty years.

Instead, he detested the work, a fact he might have realized long before he got into it. He didn't like making nice to every idiot with a buck in his pocket, he despised the whole phony nature of the profession and, most of all, he really hated not knowing when the next check was coming in. And they came in less and less frequently as his attitude spilled into his work and scared away clients.

The family was now caught in a downward spiral, made worse by the success of everyone around them. To stay afloat, the Jobses had to mortgage their house. Clara even took a part-time job. And when Steven took up swimming, she added babysitting to pay for his fees. Vacations were canceled. The car grew old. And in perhaps the ultimate statement of defeat in 1960s California, when the Jobses' color TV broke it was replaced with a black-and- white version. Eventually, to everyone's relief, Paul Jobs bailed out of real estate. But his only career choice now was to go back to work as a machinist with no seniority. He managed to find a job twenty miles away in San Carlos and the family struggled on.

Steven, now nine years old, watched in despair as the world around him, *his* world, began to crumble. Already alienated from his parents and his schoolmates, he was now, in a way he couldn't fully appreciate, also losing touch with his social class. It came to a head one day in school when his teacher asked a simple astronomy question: "What is it in this universe you don't understand?"

Little Steven Jobs, hovering over a cosmic abyss the teacher couldn't understand, answered abjectly: "Why is my family so broke?"

2.2 Revenge

Although the smartest kid in his class, Jobs became so difficult and obnoxious that he was thrown out of his fourth-grade class. Luckily, another, better, teacher took him in. Years later, Jobs would recall that the teacher found a quick motivational tool for the young man: bribes. Especially money. With the prospect of a payoff down the

line, Steven Jobs could do amazing things. So amazing that he skipped fifth grade altogether.

But skipping a grade was both an honor and a curse, because the troubled, socially awkward boy was now a year younger than his classmates. Worse, jumping to sixth grade brought Steven one year closer to Crittenden Junior High School.

Monte Loma was paradise compared to Crittenden. Located in a poor neighborhood a half mile closer to the Bay, drawing from the middle class all the way down to the bottommost economic strata, Crittenden was a school where the daughter of an astrophysicist might sit at a desk next to the deeply disturbed son of a parolee. Fights were a daily occurrence; as were shakedowns in the bathrooms. Knives were regularly brought to school as a show of macho. The year before Steven arrived a group of eighth-grade boys had gone to jail for gang rape. During Steven's seventh-grade year the school lost a wrestling match to Sunnyvale's Mango Junior High and proceeded to demolish that school's team bus.

Among the students, there were two ruling elites: the hoods, mostly Hispanic, in pointed high-heel shoes, pegged black pants, white shirts, DAs; and a small number of surfers, with long blond hair, knit shirts, baggy pants and deck shoes. Everyone else cowered in fear. And Steven Jobs, a year younger than his classmates and thus the youngest kid in school, a pariah even among the pariahs, was in the sorriest spot of all.

That summer, Steven dreaded September more than anything he'd ever known. Finally, he couldn't stand it any longer. He told his parents that if he had to go back to Crittenden, he would quit school.

What happened then was a turning point in Steven Jobs's life. He wasn't alone in fearing his school. In his neighborhood scores of families, worried about the quality of education and the threat to their children represented by Crittenden, had picked up stakes and moved elsewhere. But these were upwardly mobile families; most had planned to leave for months, even years, and the quality of schooling proved to be the trip wire.

An even greater number of kids in the neighborhood, when they expressed the same fear, or came home with a split lip and missing lunch money, were told by their less affluent parents to buck up and not be pushed around.

But when Steven Jobs made his ultimatum, the most amazing thing happened: his parents agreed. His family *moved* to a safer, and more expensive, neighborhood in Sunnyvale--despite the fact that they were working extra jobs trying just to stay solvent, despite the fact that it meant an even longer commute for his father and pulled his sister out of elementary school.

This was power. And Steven Jobs learned its lesson.

2.3 Suburbia's Child

Sunnyvale, though it abutted Mountain View, was a very different town. Younger than its neighbor, it was part of the giant landholdings of Martin Murphy, Jr., one of the first American pioneers of California.

Sunnyvale had largely grown up north (on the Bay side) of El Camino Real, and many of these older neighborhoods of bungalows and tiny homes were as rough and troubled as the one in Mountain View. Until after World War II, the land south of El Camino consisted of several square miles of orchards and farmland. It was this land that was flattened, asphalted and covered with tract homes, mostly Eichlers, to house the workers of Silicon Valley.

This section of Sunnyvale was one of the first neighborhoods to become part of the new Silicon Valley. The streets were wide, the shopping centers and light poles and sidewalks brand-new, and, because all of the newly planted trees were still saplings, everything was brilliantly lit in a sharp intense light. The city government was progressive, the public safety officers switched back and forth between being cops and firemen and crime was almost nonexistent. Even thirty years later, Sunnyvale would be named the safest city of more than 100,000 citizens in the entire United States.

This was Stephen Wozniak's world. Born in 1952, he had grown up in the stablest of families in the safest of neighborhoods. That very security, while it might temper his ambition, even when the opportunity was put in his hands, would also make him one of the few entrepreneurs in high-tech history to emerge contented from great success.

If Steven Jobs was an odd child who imposed his vision of normalcy upon the world through sheer force of will, Stephen Wozniak was the opposite: a normal kid turned odd by the power of obsession.

It didn't begin that way. Contrary to his later reputation as a nerd, Wozniak was a typical, even athletic, boy. His father had played football while earning an electrical engineering degree at Caltech; and then had spent a year as an entrepreneur, working with a partner in a failed venture to design and sell an automatic stacking machine. After that, now married and with a son, Jerry Wozniak sought out more stable corporate work. Drawn to the aerospace boom, he first found work in San Diego designing weapons, then with Lear in Santa Monica perfecting autopilots. Finally, following the path of thousands of other young engineers, he went to work at Lockheed. The family moved to an Eichler on the Sunnyvale-Cupertino border in a neighborhood that had once been the farm of an entrepreneur of a previous generation, William Wright, Jr., who had pioneered the artesian wells and orchards that transformed Santa Clara Valley from cattle ranches into a sea of fruit trees.

Even as he played Little League baseball and golf on the former orchards with his dad, the zeitgeist was already stalking Stephen

Wozniak. History, in the form of computers and Steven Jobs, was about to catch him by the tail.

There is an intersection in Sunnyvale that a cynical person might say embodies everything wrong with life in postwar suburban America. The intersection, of Fremont and Bernardo avenues, is flanked on one side by freeway on- and off-ramps and an overpass which covers a once beautiful stretch of Stevens Creek. The other two corners of the intersection are blank walls hiding two housing developments. Fremont Avenue at this intersection is four lanes wide, with a divider filled with stones. In summer this intersection of cement and asphalt bakes under an unrelenting sun. Except for the crush of cars waiting for lights or racing along the ramps, this intersection is almost completely devoid of life.

And yet, on a given evening in the late 1960s, two men and a boy would have passed one another at this intersection. One was Robert Noyce, racing home from his new company, Intel Corp., to his home in Los Altos. The other man was one of Noyce's employees, Ted Hoff, who happened to live at the intersection in a house directly behind one of those walls. The boy was a teenaged Stephen Wozniak, returning home on his bike from swim practice, his left arm scraped and sore from always having to swim the butterfly stroke in the outside lane.

Thus, the inventors of three of the most important technology products of the century, the integrated circuit, the microprocessor and the personal computer--each made possible by the one that came before--regularly converged on this anonymous and bleak intersection in a seemingly unremarkable suburban city on the edge of a continent.

2.4 Obsession

If the electronics revolution was in the air in Steven Jobs's Mountain View neighborhood, it was the very soil of Stephen Wozniak's corner of Sunnyvale. Essentially everybody in northwestern Sunnyvale and Cupertino worked in the high-tech industry or in a profession that supported it. Jerry Wozniak was a prime example: each morning he drove off to Lockheed to work on a top secret defense project. The other fathers on the street were also engineers, some at Lockheed or NASA. But as the years passed more and more worked for the new local electronics companies that had sprung up after the disintegration of Fairchild.

In this world, the neighborhood children, if they showed any aptitude, soon found themselves immersed in the world of electronics. There were odd jobs they could do for neighborhood men on weekends, such as soldering or helping to test new semiconductor devices bought at local specialty shops. A few of the more ambitions and talented boys (and it was always boys) built simple devices of their own.

And no neighborhood kid showed more aptitude than Stephen Wozniak. By the time he was ten, the neighborhood men recognized that little Stephen was a natural, even a savant, at electronics. In fifth grade, as part of this informal apprenticeship, he was given a voltmeter kit and built it beautifully. A year later, thanks to long hours spent hanging around a neighbor, Stephen built his own 100-watt ham radio station and qualified for an operator's license. He also interconnected his home with those of nearby friends in a crude communications network.

By the time Stephen entered Cupertino Junior High he was so lost in the grip of an obsession with electronics that it resembled a kind of autism. "I was all alone," he would later say. His mother, Margaret Wozniak, a strong-willed, outspoken woman who in later years would call and berate reporters if they wrote anything less than positive about "my Stephen," would remember going into his bedroom and finding the boy so intent on a new project or trade magazine article that she would have to rap him on top of the head to get his attention.

If such behavior wasn't healthy, it sure beat stealing cigarette lighters at Payless or smoking reefers or hiding under the headphones listening to the Rolling Stones or any of the other forms of teen rebellion of the day. "I was lucky," he would later tell *Wired* magazine. "Keys to happiness came to me that would keep me happy for the whole of my life. It was just accidental. I don't know how many people get it. It's like a religion or something that just popped into my head, walking home from school."

Stephen loved what he was doing. Working in the cramped kitchen, making a disaster of the standard Eichler Formica breakfast table, Stephen built an electronic tic-tac-toe game like the one he'd seen in one of his endless electronics magazines. Next he built a prototype robot.

Then came a breakthrough. Stephen had begun a new project: a basic two-function calculator circuit that had become the hot new build-at-home fad among electronics hobbyists. The actual circuit was called an adder- subtractor, which, though Wozniak didn't know it yet, was a board-level version of the same kind of transistor "gate" circuitry on the surface of the new semiconductor logic chips.

With the kind of maniacal focus that now characterized his daily encounter with the world of electronics, Stephen studied the diagram in the magazine over and over ... until he understood not only how the circuit worked but its underlying *metaphysics*. And with that understanding came the flash of an epiphany.

Now Stephen understood. Electronics could be more than just the manipulation of electricity or radio waves to achieve some physical result. It could create the world itself; becoming thought and memory. It could inhabit a universe of its own devising. And if you knew these basic components, like the adder-subtractor, you could treat them the way a conductor would a string section, calling up this instrument or that or all together. You could create a symphony of effects, a harmony--a music of digital life.

Stephen was so excited that he decided to vault the one-bit adder-subtractor described in the diagram and build a ten-bit parallel (that is, it would carry) adder-subtractor. He built it out of spare parts and with a soldering gun. There were two rows of switches on the bottom, one for addition, the other for subtraction, and a row of lights at the top from which you could read the results of the computation.

Not surprisingly, the adder-subtractor won the Cupertino school district science fair. Thirteen-year-old Stephen Wozniak, on his own, from his own design, had built a computer as powerful as any in the nonmilitary world just twenty-five years before. That alone was incredible, but more important for the future, his design exhibited uncanny elegance and conservation of parts and board space. Young Steve announced to his father that he wanted a Data General Nova, a hot new minicomputer that featured 4K of onboard memory. Jerry Wozniak informed his crestfallen son that such a machine "cost as much as a house." "Well, I'll live in an apartment," Steve replied.

Woz's childhood enchantment wasn't unique. When his protocomputer was entered in the Bay Area Science Fair that year, it earned only third place. This was an era when first place went to teenagers who built homemade Van de Graaff atomic particle accelerators. Even in his neighborhood, Wozniak was hardly alone. Walking the halls of Cupertino Junior High in that era one would have seen perhaps a half dozen kids just like him. Some were ham radio fanatics. Others built nasty electric shockers that could send arcs of blue light from every door of a bank of student lockers.

The luckiest kids were the ones whose fathers had jobs that allowed them to bring home printer-terminals. These heavy, typewriter-sized machines could, with the help of an acoustic coupler into which the family telephone receiver was jammed, talk to a distant mainframe computer. This was heaven itself, especially when you could "talk" to one of those programs that, in rehearsal for some future Turing test, would converse with you by rifting off your own statements. If your dad worked for NASA-Ames you could even sit in the lobby of one of the buildings there and talk to a computer this way for hours--for free! It was amazing. You could feel the power of digital reality, a new life form, through your fingertips.

Each year it seemed there were more and more of these boys who had been inhabited by electronic dreams. Anywhere else--say, up the road in Steven Jobs's neighborhood--they might have been tortured by fellow students for their strangeness. Even at Sunnyvale High School, across town, this was still true. But not in Cupertino, and not at Homestead High. Homestead, upper-middle-class, almost exclusively white and Asian, was instead a kind of sanctuary for the brilliantly dysfunctional. Not only was it among the best schools in the South Bay, it also had the resources to respond to this influx of odd newcomers.

In particular, there was a class at Homestead in electronics taught by John McCollum. It would prove as important to the computer age as Fred Terman's electronics class at Stanford had been for Bill

Hewlett and David Packard three decades before. There, at last, Stephen Wozniak's private love and public education could become one.

2.5 Homesteading

From the moment he arrived in McCollum's class, in which he quickly became the shining star, Wozniak's life seemed to take a sidetrack from the rest of mankind. In an obvious way, he seemed to stop developing emotionally like his peers, but instead drifted on in pursuit of his Cyber Circe. The rest of his studies suffered, as did his social life. His classmates would see him all day, in homeroom and other classes, sketching out new circuit designs, absentmindedly drifting off to conduct rondos and sonatas with the brass, woodwinds and strings of logic chips, memory devices and linear circuits. By the time he finished high school, Woz had designed fifty computers on paper.

Stephen Wozniak, the boy who played golf and swam competitively and watched television, the typical suburban boy, had now become the Woz. The great achievements were still years ahead; and for now the new persona, unadorned by fame, was not a pretty sight.

One characteristic of the new Woz was a singular lack of understanding of human behavior and the boundaries of social etiquette. And nowhere was this more evident than in his practical jokes--a lifelong predilection that took on twisted new forms in the hands of the Woz.

The most celebrated example of this was the bomb scare. Using some old- fashioned, stick-shaped dry cell batteries, some wire and an oscillator chip to produce a reliably loud clicking sound, Woz constructed a pretty good simulacrum of a dynamite device. He put it in a friend's locker and gleefully awaited the result.

He got more than he bargained for: the bomb squad. Evacuated buildings. Hysteria. And the crowning touch: William Byrd, the school principal, rushing up, grabbing the "bomb" and sprinting with it--sweat flying, tie flapping, leather shoes clicking on the cement hallway--out to the football field. There, expecting death at any second, he yanked out the wires.

By most measures, Byrd was a hero. Except one: Stephen Wozniak had made a complete fool of him. Woz somehow never anticipated any of this. He trotted off to the principal's office later that day expecting to receive a math award--and instead was arrested and thrown into juvenile hall overnight. But what is perhaps most telling about this episode is that Margaret Wozniak bailed out her son the next day, all the while screaming at the cops and anyone else in earshot that her son was the suburban equivalent of a political prisoner, that she was surprised he hadn't had a number tattooed on his chest and thrown into San Jose's equivalent of

Bergen-Belsen. Stephen's sister Leslie got into the act too, writing an exposé on the affair of the faux bomb in the school newspaper she helped edit.

Despite the troubles at school, which included not just the bomb prank but falling grades in other courses as electronics took over more and more of his life, Woz was also becoming one of the more celebrated students at Homestead. Single-mindedness is not a common trait in high schoolers, and single-mindedness combined with genius appears rarely indeed. Stephen Wozniak was that student. Often those students are hated by their classmates, but the Woz was too friendly (if distracted) to have enemies.

Instead, his classmates mostly just stood back in amazement as the Woz devoured every bit of knowledge in McCollum's class and then begged for more. One of the glories of Silicon Valley, then and now, was the proximity of some of the best minds and technology in the world. McCollum wisely found a school credit internship for the boy at GTE Sylvania, a microwave telephony research facility in Mountain View. Joining Woz there was his closest friend, Allen Baum, the only other kid at school who could remotely keep up with him in electronics.

The two boys were lucky to have landed at Sylvania. In Silicon Valley at this time there were perhaps a dozen mainframe computers. Some, like those at NASA-Ames and Lockheed, were largely inaccessible. Others, like those at Hewlett-Packard, were simply too busy doing payroll and engineering simulations. But Sylvania was a looser place, an R&D lab whose fiberglass bubble dome rose over the surrounding orchards as a South Bay icon.

The mainframe used by Sylvania was nothing special, an IBM 1130 that in the words of one author "was about the size of a refrigerator, shook the floor when it operated, and was so loud that shouting replaced normal conversation." It required punched computer cards for input and had about the same computing power as a modern fifty-dollar handheld video game. But Stephen Wozniak would have sawed off his arm to own it.

High school technical internships in the late 1960s and early 1970s are a rarely noticed factor in the creation of the modern Silicon Valley. Yet these programs, at Ames, Lockheed, Sylvania, the Stanford Linear Accelerator and elsewhere, were of incalculable value to the founders of personal computing; and it is no coincidence that the early organizations in this field had their beginnings at these sites.

Certainly the internship at Sylvania, with the mainframe at hand and friendly scientists more than happy to help a young kindred soul, had a profound effect upon the Woz. He arrived an electrical technician of native genius and left a computer scientist of nearly infinite potential.

Until now, Woz had dealt with electronics as a hardware exercise. You had a problem to be solved and you did so using some configuration of the hardware tools of electronics: the old linear

devices like capacitors, oscillators, resistors; discrete devices of more recent vintage like diodes; and the new digital integrated circuits, including ROMs, RAMs and TTL logic. The obvious difficulty in this method--the only method the engineering world had known until recently--was that the more complex the problem, the more complicated the hardware setup needed to address it. In this world, the most gifted engineers were those who could puzzle out novel ways to reduce the number of components by, say, 10 percent. And it was in this particular type of simplification that Woz had shown almost supernatural talent.

The encounter with the Sylvania computer changed Wozniak's life because, thanks to helpful explanations from the scientists and time spent playing with the machine itself, Woz saw, literally in a flash of lights, another, *better* way.

What the scientists showed him was how the compiler of the 1130 worked. Thirty years later, the millions who use a personal computer, whether they know it or not, have a good idea of how a compiler works. When you type in a command, or drag a window across the screen with a mouse, you know that the computer is actually taking this information, converting it in software to a series of instructions in the ones and zeros of binary code, then performing the requisite operations in hardware, then translating the results through software--moving the window, erasing a word, drawing a shape--back onto the screen.

We understand this because Woz taught us. But the teacher himself had to be taught; and the education of Stephen Wozniak took place during those days at Sylvania. The lesson wasn't self-evident. As with most electrical engineers of the era, Woz's notion of data processing was computation, and his image of a computer was a calculator. Thus, the music of electronics he heard in his head, complicated as it was, remained merely a melody, a string of distinct events leading toward a conclusion.

What transformed Wozniak at Sylvania was the realization that there was another world in electronics, *software*, that would make the music infinitely richer and more ambitious through counterpoint, minor chords and repetitive refrains. He learned one of the early computer languages, FORTRAN, and began programming the 1130 to do things he had never before imagined possible. From now on, he would create symphonies.

Again, Woz wasn't the only teenager in Silicon Valley learning about computers. All those boys tapping into distant mainframes through the acoustic modem and terminal Dad brought home from work every Friday night were doing the same thing. Out at NASA-Ames, Foothill Community College taught a course in programming on Saturday mornings that was jammed with students ranging from high schoolers to pensioners. But what made Woz almost unique among the young budding programmers was his already vast experience in circuit design. And even as he was finishing his Sylvania internship, Ted Hoff, that neighbor he passed in the intersection, was working a few miles away at the Intel Corp. plant

in Cupertino to create the microprocessor, the electronic device that would bring Woz's two great skills together.

(Continues...)