Silicon Valley
Program Transcript

Narrator: In June 1957, at San Francisco's luxurious Clift Hotel, eight of the country's most talented young scientists and engineers assembled for a secret meeting.

For the previous 14 months, they had been working together at Shockley Semiconductor Laboratory outside of Palo Alto, developing a technology that promised to be revolutionary. But in recent months, William Shockley, the head of the company -- and the mind behind that technology -- had become increasingly erratic.

Now, the eight were conspiring to defect -- to quit Shockley and form their own firm, under the leadership of one of their own, 29-year-old Robert Noyce, a Midwesterner with a brilliant scientific mind and the genuine affability of a born salesman. It had taken some convincing to get Noyce on board.

Leslie Berlin, Author, The Man Behind the Microchip : Noyce had a young family. And to leave sort of a known paycheck for something that there was no model for, this notion of breaking away and doing something different.

Narrator: Soon it came time to seal the deal. In the absence of an official contract, newly-minted dollar bills were passed around the table for signatures. Noyce got out his pen.

Michael S. Malone, Writer: I honestly think that Silicon Valley begins on a very specific morning. That morning is the morning that the guys from Shockley don't know if Noyce is gonna go. And he gets in the car that morning and goes with 'em.

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Leslie Berlin, Historian (audio): Those dollars bills they signed are Silicon Valley's declaration of independence. A statement that we are going to go out and start a company according to our own ideals, and our own beliefs, and nothing is gonna stop us.

Narrator: On that morning in 1957, none of the eight defectors likely had any idea what would happen next.

The coining of the phrase "Silicon Valley" was more than 10 years in the future. The unique business culture with which the place would come to be associated -- openness over hierarchy, risk over stability, innovation over the tried-and-true -- had still to be tested. And the integrated circuit -- the revolutionary technology that would usher in a new era in human history -- had yet to be invented. That morning, the future Silicon Valley was just a speck on the map -- and a most unexpected place for the Information Age to begin.

Had it not been for William Shockley, everything that was to come might well have happened somewhere else. At the time that Shockley planted his flag in California's Santa Clara Valley, south of San Francisco, in 1956, the area was known mainly for its orchards -- mile upon lush, green mile of fruit trees, heavy with apricots, cherries, almonds. Marketers had dubbed it "The Valley of Heart's Delight."

Jay Last, Physicist: When I was 16, I was living in a steel mill town in Pennsylvania and had a free summer between my junior and senior year and decided to hitchhike to California. And I spent the summer picking apricots in Santa Clara Valley. It was just an unbelievably beautiful area with all these fruit trees.

Narrator: Far from the nation's banking and manufacturing centers, the Santa Clara Valley was not, at first glance, an obvious spot for a technology company. All of the leading electronics firms -- Westinghouse, General Electric, Raytheon, IBM -- then had their headquarters on the East Coast.

But Shockley had personal ties to the Valley -- his mother had lived there for years -- and the land was blessedly cheap. Hoping to entice aerospace and electronics companies to the region, Stanford University was offering long-term leases in Palo Alto at bargain-basement prices.

Kathleen Cohen, Palo Alto Resident: Setting aside land that could be leased to those companies was I think a very, very important thing. And so we have the university then connecting with industry.

Arthur Rock, Venture Capitalist: This just created a terrific atmosphere for entrepreneurship.

Narrator: By the time Shockley set up his laboratory, a handful of other electronics firms -- Hewlett-Packard, Varian, Litton -- also operated in the Valley, as did the missile systems division of Lockheed Aircraft.

Here and there, the agricultural landscape already was beginning to give way to suburban subdivisions and large industrial structures. And as they had more than a century earlier during the Gold Rush, Americans were heading to California in ever-increasing numbers -- some 3,000 a month in the late 1950s -- in search of opportunity.

Kathleen Cohen, Palo Alto Resident: People came to California to get started again in their lives in new directions. The idea of the new is a very exciting thing for Californians. You're not as limited to what has gone before.

Narrator: For Shockley and the other entrepreneurs in the Valley, there was the genuine feeling of starting something from scratch.

Regis McKenna, Marketing Consultant: This was pretty much a technological wilderness when they came here. Like the early pioneers that moved west, they somehow struck out without really knowing what the outcomes were going to be.

Narrator: Like many of the new arrivals, William Shockley had made his name in the East. One of the most legendary applied physicists in the history of science, he had spent much of his career at Bell Telephone Laboratories, the renowned private research and development firm in New Jersey. It was there, in 1947, that he had become famous -- as one of the inventors of a tiny electronic device known as a transistor.

Demonstrator (archival): "It's a transistor, no bigger than a kernel of corn."

Michael S. Malone, Writer: The transistor is a turning point in technology history -- and actually human history -- because it's taking an existing technology and moving it into a whole new dimension.

Narrator: Since the 1930s, most electronics -- everything from television sets to hearing aids -- had run on vacuum tubes. They were behind the transmission of telephone signals, radio, and radar -- and also ran the world's first electronic general purpose computer, which was built by the U.S. Army during World War II and popularly known as a "Giant Brain."

Michael S. Malone, Writer: It was the fastest computation machine anyone had ever seen, but it had one big problem. It was the size of a warehouse, and these tubes consumed a lot of electricity, and they used to joke that when you turned it on it dimmed the lights of the city around it. And you had to have men run around inside the computer changing tubes because they burned out pretty quickly.

Narrator: Vacuum tubes, like light bulbs, worked by heating up a thin metal filament -- and as with light bulbs, the filament burned out from time to time, requiring the tube to be replaced. The transistor, by contrast, was virtually indestructible.

Ted Hoff, Electrical Engineer: The transistor represented a major advance in being able to do electronic work with far less power and a far smaller device.

Instructional Video (archival audio): What's inside the transistor? Dr. Shockley shows us using a huge scale model. Inside are two pins ...

Narrator: The key to the transistor was a chemical element known as a semiconductor. In between materials like metals, which conduct electricity easily, and insulators such as rubber and glass which block electricity, a semiconductor could do both -- enabling it to act as an electrical switch. By exploiting the properties of the semiconductor germanium, Shockley and his colleagues had invented a device with the potential to completely transform the electronics industry.

One of the first hints of what was possible came in 1954 with the transistor radio -- which was small enough to fit in a pocket. The transistor radio quickly became the most popular electronic communication device the world had ever seen.

By 1955, scientists and electrical engineers all over the country were racing to develop new applications for the transistor. Shockley had more ambitious plans: to exploit the commercial potential of the transistor -- and make it the cornerstone of a large and potentially lucrative new industry. He decided to leave Bell Labs, founded his own firm in California, and began raiding PhD programs and electronics companies for gifted, young recruits.

Gordon Moore, Chemist: He knew chemists had been useful to him at Bell Laboratories so he thought he needed one in his new operation, and he got my name and gave me a call. Fortunately, I recognized who it was. I picked up the phone, he says, "Hello, this is Shockley."

Jay Last, Physicist: He just showed up in my lab at MIT one day, and I thought, my God, I've never met anybody this brilliant. I changed my whole career plans and said, I wanna go to California and work with this man.

Narrator: Bob Noyce, then a 28-year-old research manager at Philco, the Philadelphia-based electronics firm, was equally impressed. As he would later say of his phone conversation with Shockley: "It was like talking to God." Just over a month later, Noyce was headed out to California, an interview at Shockley Laboratories scheduled for the following morning.

Michael S. Malone, Writer: It was a chance for him to be among the best and the brightest young scientists in America, a chance to work with this acknowledged genius. And Shockley was making noises about how he was gonna transform the electronics industry with brilliant new inventions. I mean, how do you say no to something like that?

Narrator: Shockley touted his new team as the "most outstanding in the semiconductor field": a dozen and a half young scientists of various stripes -- physicists, electrical and mechanical engineers, metallurgists, tool builders -- all of them rising stars in the field, all but a handful under the age of 30.

Jay Last, Shockley Semiconductor: We were all about the same age, and we had made scientific accomplishments on our own before that. We were very, very compatible with our scientific training, and with the way we looked on the world.

Narrator: There was Jay Last, a Pennsylvania-born physicist with a doctorate from MIT; chemist Gordon Moore, who had grown up in the farm country north of the Santa Clara Valley but had spent the last two years at Johns Hopkins Applied Physics Lab; Jean Hoerni, a theoretical physicist from Switzerland with two doctoral degrees and a glowing employment recommendation from Cal Tech; and Robert Noyce, a native of Iowa with a PhD from MIT -- and the Shockley team's resident expert on transistors.

Vic Jones, Shockley Semiconductor: There was no one there other than Bob Noyce who was really well-grounded in semiconductors. Gordon Moore, Jay Last, and myself, we used to get there at six and try to teach ourselves semiconductor physics for the first hour in the morning.

Jay Last, Shockley Semiconductor: I had never seen a transistor until I went to work for Shockley. Bob knew and understood transistors very well. And talking to him was a way of really learning a lot of stuff very quickly.

Narrator: By coincidence, Noyce had been introduced to the transistor soon after its development at Bell Labs. He'd been an undergraduate at Iowa's Grinnell College then, studying under Grant Gale -- a physics professor who just happened to have to gone to college with one of the transistor's inventors. At Gale's request, Bell Labs sent over the technical reports on the new device. Noyce devoured them. With the transistor, Noyce knew he was looking at the future. "The concept hit me like the atom bomb," he later recalled. "It was one of those ideas that jolts you out of the rut, gets you thinking in a different way."

Jay Last, Shockley Semiconductor: The transistor was still a laboratory curiosity at Bell Labs during that period.

Michael S. Malone, Writer: It somehow manages to get to Iowa to a little liberal arts college in the middle of the country, and sitting there in the class is the man who's gonna make it all happen. The odds are astronomical of any of this occurring.

Narrator: Noyce went on to study transistor-related technology at MIT, then took the job with Philco, in its newly-formed transistor division. Bright and personable, he was quickly promoted to manager -- and just as quickly came to the conclusion that the bureaucracy of East Coast corporations did not suit him.

Regis McKenna, Marketing Consultant: Places like Philco, and Bell Labs, and IBM -- they were very large, hierarchical kinds of companies and businesses. And it was very structured. Philco was so structured that your status and your furniture was determined by a book that actually had your title and your position in the company and what sort of furniture you were

allowed to have in your office at that time. And so everything was put in a rulebook of some kind. It was very stifling and limiting in your own freedoms.

Leslie Berlin, Historian: Noyce wanted to be a scientist -- to be in a lab all day, every day. He quickly discovered that he hated management. He had imagined himself as an independent operator.

Robert Noyce (archival audio): Philco was doing good work in transistors, but Shockley was the top of the field. And I wanted to see if I could compete with him, if you will. I wanted to play in the big leagues.

Narrator: In California, Noyce would get his chance.

In 1956, Shockley Semiconductor had all the makings of a success: solid financial backing from a Southern California technology company, Beckman Instruments, and a straightforward mandate -- build a commercially viable silicon transistor.

At that point, the standard semiconductor used in transistors was germanium. But germanium functioned poorly at high temperatures -- making it spectacularly ill-suited to meet the demands of the burgeoning defense industry, with its heat-producing missiles and planes. The solution was to create a device built from germanium's more stable, more heat-resistant cousin, silicon. But silicon was difficult to work with, and its conductivity hard to manipulate. Shockley wanted to try a new method.

Gordon Moore, Shockley Semiconductor: We were all going through a learning experience with silicon and this new technology. And we were making some progress but there was still quite a long ways to go.

Narrator: Then, about six months into the project, came news that Shockley had been awarded the Nobel Prize -- along with two of his colleagues from Bell Labs -- for inventing the transistor.

Gordon Moore, Shockley Semiconductor: We adjourned to salute the honor with champagne starting at nine o'clock in the morning at a local restaurant.

Narrator: All of them would later mark that celebration as the beginning of the end.

Jay Last, Shockley Semiconductor: The whole atmosphere changed very quickly, and it deteriorated very rapidly.

Narrator: Shockley's ego -- outsized to begin with -- now threatened to eclipse his genius. He became rigid, authoritarian, impossible to please.

Vic Jones, Shockley Semiconductor: He began to show lots and lots of anger towards people who weren't doing things according to what he wanted to do.

Narrator: Without warning or explanation, Shockley demanded that much of his team shift its focus from the silicon transistor to a complicated new device called a four-layer diode.

Gordon Moore, Shockley Semiconductor: Bob Noyce and I wrote a pretty strong memo to him as to why the transistor was where he ought to continue to work, but it didn't seem to have any significant impact.

Jay Last, Shockley Semiconductor: This four-layer diode wasn't coming along very fast. With the path we were on we were never going to have a commercial device. He couldn't face up to the fact that he'd made a bad decision so he started blaming all, everybody around him. He was very abusive. I went from being his fair-haired boy to being one of the causes of all his problems. It was very painful to me.

Michael S. Malone, Writer: They knew how good they were, and Shockley was treating them as if they were children. They would come in with a great idea and Shockley would get on the

phone and call one of his old colleagues at Bell Labs and say, "What do you think?" It must have been very, very difficult to be told every day told that you can't be trusted with your own ideas.

Jay Last, Shockley Semiconductor: We'd go away for the weekend and bemoan the problems we were getting into with Shockley, and trying to understand why things had all of a sudden had gotten so difficult with the man.

Narrator: Eventually, seven of the company's top scientists and engineers -- Jean Hoerni, Julius Blank, Victor Grinich, Eugene Kleiner, Gordon Moore, C. Sheldon Roberts, and Jay Last -- decided to take matters into their own hands. They contacted Shockley's boss, Arnold Beckman, and requested that Shockley be removed as manager.

Gordon Moore, Shockley Semiconductor: Beckman essentially told us, "Shockley's the boss, take it or leave it." We discovered a group of young PhDs couldn't push aside a new Nobel Prize winner very easily.

Jay Last, Shockley Semiconductor: So we were just completely sandbagged, and we realized then we had to leave. We had really burned our bridges.

Regis McKenna, Marketing Consultant: The business culture that existed in this country was that you go to work for a company, and you stay with that company, and you retire with that company. People did it at General Motors, people did it at Ford Motor Company, people did it at Philco. This was what traditional East Coast -- and even Midwestern -- American values were.

Michael S. Malone, Writer: These guys all joined on the belief that they would stay there forever. And it really took the incredibly bad management skills of Bill Shockley to alienate them so badly that they would contemplate just stepping out the front door into the abyss.

Narrator: Shortly after the attempted coup at Shockley, a letter landed on the desk of Arthur Rock, a financial analyst at the Wall Street investment firm of Hayden Stone.

Arthur Rock, Venture Capitalist: The letter essentially said that there were seven people connected with Shockley Laboratories who were thinking of leaving and did we know any company that would like to hire them.

Gordon Moore, Shockley Semiconductor: Arthur Rock came out to meet with us. He told us, "What you really wanna do is set up your own company, and we will find you financing."

Jay Last, Shockley Semiconductor: None of us really knew many details of what was involved in running a company. But it just looked like a very exciting direction to go.

Narrator: At that moment, Robert Noyce was not among the defectors. But they all agreed the new venture needed him.

Gordon Moore, Shockley Semiconductor: Bob was the kind of person everybody liked when they first met him. He had that personality that came across very smoothly. And, as such it opened doors. And of course he was brilliant, which helped.

Narrator: Thanks to his knowledge of transistors, Noyce had been given some real authority in Shockley's lab, and he was reluctant to walk away -- at first.

Robert Noyce (archival audio): I felt that I had a commitment to Shockley, and I wanted to do everything I could to make that organization work. And so I felt that my first obligation was to try to talk those seven folks into not leaving. When I failed in that, I felt that I should join them.

Narrator: Now, they were eight.

Jay Last, Shockley Semiconductor: Our real aim was to keep working together. We knew we could build a transistor that was gonna be a very successful, innovative product.

Michael S. Malone, Writer: They've, in a sense, already rolled the dice in a big way just being where they are. You go to California, you leave your life behind, you strike out to try something new and to start your life over. And the job turns out to be a nightmare. Now you get to the moment of decision: are you gonna roll the dice one more time?

Narrator: In New York, Arthur Rock was working the phones in search of a backer.

Arthur Rock, Venture Capitalist: We made up a list of 45 companies that might be interested, but none of them were willing to take on a separate company division. They felt that their own employees would have problems with it, that they would see it as a way that someone else made a lot of money at their expense. They just couldn't get it through their heads that this was a good opportunity. We had a couple of months of doing this and were about to give up, when someone suggested that I see Sherman Fairchild.

Narrator: A prolific inventor and entrepreneur, Sherman Fairchild was the owner of Fairchild Camera and Instrument, a New York-based manufacturer of aeronautic, electronic, and photographic products. He was also the largest single stockholder in IBM, the computing giant his father had co-founded.

Arthur Rock, Venture Capitalist: Sherman Fairchild was well known and well respected and used to tinkering around with things. And he immediately saw the potential in this.

Jay Last, Physicist: Sherman Fairchild had the vision and the interest in us. He was very rich, had a very great imagination and enthusiasm for things. And if it hadn't been for him I don't know if we would've found a sponsor.

Narrator: Fairchild readily agreed to put up $1.3 million. In exchange, he retained an option to buy out the new subsidiary. If Fairchild Semiconductor were successful, the parent company was

positioned to reap the benefits. Shockley Laboratory was about to suffer an exodus of talent from which it would never recover.

Gordon Moore, Chemist: Shockley was crushed. He looked like a beaten puppy as he walked out the door that day.

Narrator: With Shockley reeling, Beckman issued a warning to the eight defectors.

Leslie Berlin, Historian: They were told, "This is a shameful act. You need to consider the consequences. You have essentially turned traitor. You have broken what everyone knows is the contract that you make when you start working at a company, which is: You're there forever. You've changed the rules of the game and you're never gonna live that down."

Michael S. Malone, Writer: It looks easy nowadays because we have a tradition -- largely set in motion by those guys -- where it's accepted in this town. You're better off to go out and start your own company and fail than it is to stick at one company for 30 years. The real respect comes from going out there and being an entrepreneur. But that wasn't true in the 1950s. The cost of failure now is small. The cost of failure back then was enormous. It must've been scary as hell.

Newsreel Announcer: "Today a new moon is in the sky, a twenty-three inch metal sphere placed in orbit by a Russian rocket..."

Narrator: The news stunned America. On October 4th, 1957, the Soviet Union successfully launched Sputnik, the first space satellite -- dealing a powerful technological blow to the United States, and intensifying the anxieties of the Cold War.

Regis McKenna, Marketing Consultant: There was this underlying fear that existed that we were imminently going to be at war with Russia, and that it was probably going to be a

nuclear war. Once they were able to demonstrate that they could put a payload into space, that said that probably we were much more vulnerable as a country.

Arthur Rock, Venture Capitalist: The Russians had just beaten us at our own game, and I think everyone in this country was just befuddled by it. How could this happen? How could they beat us?

Douglas Edwards, archival, CBS News: The course of United States policies in the competition with Russia has been severely shaken. This is Douglas Edwards, good evening.

Jack Yelverton, Fairchild Semiconductor: Sputnik caught the attention of everybody. All of a sudden there was a real recognition that we needed to be a, a more technically-oriented society.

Narrator: In the wake of the Sputnik launch, President Eisenhower signed the National Aeronautics and Space Act, establishing NASA. The agency began operations in October 1958; within two years, its budget would top 400 million dollars a year.
For recently-incorporated Fairchild Semiconductor, the nation's new obsession with technology would prove the business opportunity of a lifetime.

Leslie Berlin, Historian: The space race is on and the federal government suddenly has an insatiable need for precisely what these guys are going to start building.

Narrator: Fairchild Semiconductor -- soon-to-be manufacturer of silicon transistors -- set up shop just down the road from Shockley, renting out a concrete slab of a building that amounted to little more than walls and a roof.

Gordon Moore, Fairchild Semiconductor: At Fairchild we had a clean slate. We had an empty building and we could do it the way we now thought was the right way to do it.

Jay Last, Fairchild Semiconductor: The building had no electricity, the phones, water. We didn't have any toilets, we had to go to the gas station down the street. A main topic of discussion always was, "How soon are we gonna get the power and be able to start in?"

Jack Yelverton, Fairchild Semiconductor: There were challenges and problems everywhere. You had to build the equipment that you needed to make these transistors. It was a whole, brand new world that nobody had been there before.

Jay Last, Fairchild Semiconductor: We had the basic technology, but all of the details we had to do ourselves... and invent ourselves. I remember the group of us cleaned up the floor and said, "Alright, now we, we're in business."

Narrator: Fairchild Semiconductor had barely opened its doors when the team got wind of a potential sales opportunity.
The Air Force had hired IBM to build a navigational computer for the new supersonic B-70 bomber.

What the military needed was silicon transistors that were not only capable of withstanding high temperatures, but also fast-switching. The most likely supplier was the largest semiconductor manufacturer in the country, Texas Instruments -- or TI -- but the silicon devices TI was making were too slow.
IBM invited the upstart Fairchild to bid on the contract.
A meeting was set up at IBM's Federal Systems Division in Owego, New York. For the Fairchild founders, there was no question that Robert Noyce would be the one to make their pitch.

Jack Yelverton, Fairchild Semiconductor: Bob had the ability to charm anybody. He had a great smile, he had a quick wit. And when he walked into a room people would sit up and pay attention.

Leslie Berlin, Historian: Fairchild at this point was three months old, in talks with IBM, one of the great companies in the country.

Narrator: The device the military wanted pushed the bounds of existing technology. To date, no electronics company had built a single one. IBM needed a sample batch of 100.

Charlie Sporck, Fairchild Semiconductor: IBM laid out the specification they needed. And they turned to Bob.

Leslie Berlin, Historian: One would expect that Noyce might be a little bit quaking in his boots when he hears, "Well, the only way you can get this contract is if you can build 100 of these."

Charlie Sporck: Bob's thinking about it and he says, "Yeah, we could do that." Now, you understand, they hadn't made... they hadn't built this transistor yet.

Narrator: Noyce's confidence won Fairchild the contract -- and the fledgling company's chemists and engineers went to work.
They had already decided to split into two R&D teams -- and now, under intense deadline pressure, they were racing against one another to develop a transistor that met IBM's specs.

It took five months, but in July 1958, Fairchild fulfilled its first order: 100 silicon transistors at 150 dollars each -- 30 times the going rate for the less-sturdy germanium standard.

Jay Last, Fairchild Semiconductor: We hadn't thought about how you shipped the device. So I went down to the supermarket and got a Brillo box. And the first product went to IBM in a Brillo box.

Jack Yelverton, Fairchild Semiconductor: When IBM starts buying your transistors and using them in their equipment that tells the rest of the world that you've got something.

Jay Last, Fairchild Semiconductor: When I look back on it now I'm just flabbergasted that we did what we did. We took the basic Bell Labs technology, and turned it into a product that nobody in the world had ever made before. We went to our first trade show, and we got an enormous reception.

Narrator: As a triumphant Noyce put it to the Fairchild staff: "We scooped the industry."

Robert Noyce (archival audio): I grew up in small town America, which had to be self-sufficient. If something was broke you fix it yourself. We didn't have the expertise around so we all had to be experts.

Michael S. Malone, Writer: Noyce comes from a generation that we won't see again in the electronics industry. These are people that grew up in a world without electronics. Where they got their technical chops, it's almost magical. Dad may have bought a ham radio, they may have had an affinity to working on equipment on the farm. But what's interesting about them is they all share those sort of "middle-American values." They were basically honest, they were as good as a handshake. There was a constant tension between being masters of the universe and living in small town life. That tension drove these guys on.

Narrator: Right out of the gate, Fairchild Semiconductor had managed to capture the industry's attention. But building a cutting-edge transistor was only half the battle. The key to success was being able to mass-produce it.

Jay Last, Fairchild Semiconductor: Our main goal was just figuring out how to make a lot of these things -- reliably and in short order.

Charlie Sporck, Fairchild Semiconductor: When you're building an automobile, 100% of the time the car comes out. When you're building semiconductors, sometimes a chip comes out, that works. Frequently, nothing comes out.

Michael S. Malone, Writer: Chip yields, the amount of chips that actually worked when they came off the line, were going up and down unpredictably. There are stories where they discovered it was because there were farm fields outside, and whenever they put down pesticide it would affect the yields on chips. The yield would change with the water level in the ground. If men didn't wash their hands after going to the bathroom, the uric acid crystals would wipe out hundreds of chips. It was an incredibly crude process.

Narrator: The select few working transistors had to be mounted, connected to lead wires, and put in casings -- a delicate, labor-intensive task performed almost exclusively by women.

Jack Yelverton, Fairchild Semiconductor: It was just a given in the industry at that time. The belief was that women were used to doing needlework and working closely with their hands, and they had better hand-eye coordination.

Ginger Jenkins, Fairchild Semiconductor: It was all manual dexterity. My starting job at Fairchild was called a die-attacher. A die is a tiny little silicon chip. I attached 'em to the package, with the gold layer under the silicon piece. And then after I was done it would go to the bonder, who would attach little wires to it.

Jay Last, Fairchild Semiconductor: When our devices came along, there was an instant acceptance of them. It was the ideal component -- the small size and weight, the high performance, the ability to perform under very high temperature requirements. The only thing we had to figure out to do, we knew they had to be reliable.

Narrator: The reliability of Fairchild's product was put to the test in 1958, when the upstart company beat out its more established rival, Texas Instruments, to supply transistors for the guidance system on the Minuteman nuclear ballistic missile.

Charlie Sporck, Fairchild Semiconductor: The Minuteman program was a godsend for us. The military was willing to pay high prices for performance. How does the small company compete against the giant TI or Motorola? It has to have something unique. And then it has to have an outlet. Certainly the military market was very important for us.

Narrator: For the military, reliability was essential -- and the first Fairchild transistors did not measure up. An alarming number of devices had to be returned to the company for so-called "random catastrophic failure." Lab tests revealed that it took nothing more than a sharp tap with a pencil to make the transistor stop working all together.

Jay Last, Fairchild Semiconductor: Here we had the product that scooped the industry and all of a sudden, we didn't have a reliable product. We realized that when we were sealing these up, little specks of metal would be loose inside the can and short out the device sometimes. We were really running scared. It would've been the end of the company. We needed to solve the problem.

Narrator: For more than a year, physicist Jean Hoerni had been working on a radically new transistor design: a thin, protective layer of silicon oxide mounted on top of the transistor. Now, he and Noyce believed its time had come.
The concept moved quickly from sketch to basic component–-and then was rigorously tested and refined.
In a nod to its flat top, Fairchild dubbed Hoerni's innovation the "planar process."

The method not only solved the reliability problem, it actually improved the transistor's overall performance.

Jack Yelverton, Fairchild Semiconductor: The planar process was a major step forward in the ability to make silicon transistors. Using the planar process you had a very clean and more highly reliable transistor. You could increase your yields, you could reduce your costs, and make a much better product.

Narrator: Fairchild immediately took out a patent.

Charlie Sporck, Fairchild Semiconductor: With the planar process, all hell broke loose. Everybody else had to come to our door and plead with us to get a license.

Narrator: As orders began pouring in, Fairchild Camera and Instrument decided to exercise its option to buy its upstart subsidiary.

Each of the eight co-founders of Fairchild Semiconductor received stock options worth almost 300,000 dollars -- roughly 2 million dollars today. "The money doesn't seem real," Noyce told his father, "It's just a way of keeping score."

Michael S. Malone, Writer: If you look close enough at history, most inventions are not out of the blue. They tend to arise out of a milieu where the time for that invention has come. In the late 1950s, we had the transistor. It's now being sold in the millions. It's got one problem: it's a discrete device, it does one thing. And if you wanna do two things you have to have two of 'em. And if you wanna build a big computer that does 10,000 things, you've gotta have 10,000 transistors.

Leslie Berlin, Historian: The more of these discrete components, the number of connections between them grows exponentially. So you could end up in a situation where you could have all of the independent components testing out as working, and you could have the circuit fail because the connections between the components were failing. So, there were efforts all over the country, people trying to figure out "How can we somehow, at the same time that we build these components... how can we also connect them to each other in a single device?"

Military might depended on being able to build these rockets and missiles, and so the Department of Defense was willing to pay almost anything for a lightweight, reliable circuit.

Narrator: The answer, when it came, caught Fairchild off-guard. In March 1959, at an industry trade show in New York, Texas Instruments announced that it had patented an entire circuit on a single semiconductor chip -- effectively trouncing the competition.

Designed the previous fall by an engineer named Jack Kilby, TI's so-called "solid circuit" spurred Fairchild to action. "We were working day to day," Noyce recalled, "to try and get a competitive edge."

Jerry Sanders, Fairchild Semiconductor: At the time TI was the biggest company in the world in semiconductors. And Fairchild was just a, you know, peanut... and wanted to be beat TI. I was at an industry show, and I ran into a manager from Texas Instruments. I walked up to him and shook his hand, or tried to shake his hand. He looked at me like, you know, I was garbage, and said, I'll never forget it, "Fairchild, we're gonna crush you guys." And I thought, "Wow! That is really weird!" So there was just a lot of hysteria against, you know, Fairchild as it was making its way.

Narrator: As head of R&D, Robert Noyce had been thinking about ways to connect components for some time. In fact, two months before TI's announcement, he'd sketched some ideas in his lab notebook for a device that would come to be called "the integrated circuit."

Les Vadasz, Fairchild Semiconductor: The integrated circuit idea is that, hey you don't have to have individual devices. You can have all these devices in one piece of silicon, and interconnect them right on that silicon chip.

Narrator: Building on Fairchild's planar process, Noyce's design linked individual components together with tiny metal lines printed right on the protective oxide layer.

Kilby's design, by contrast, relied on thin gold wire, painstakingly threaded between the components by hand.

Jerry Sanders, Fairchild Semiconductor: Jack Kilby just wired them together. Bob Noyce said, "No wires." In no way do I wanna demean Jack Kilby's work. I mean it's, you know, it was fantastic. But it wouldn't have been practical for mass production.

Roger Borovoy, Fairchild Semiconductor: I've worked with a lot of brilliant people in my career and he is at the top. He had a way of of integrating facts and coming up something you'd never expect.

Narrator: Now, jolted by TI's news, Noyce hurriedly resurrected his notebook sketches.

Jay Last, Fairchild Semiconductor: Bob and I got together and said we have to show the flag somehow. So I made some crude devices that we had at one of the trade shows.

Narrator: Noyce filed a patent for his integrated circuit in July 1959.

By then, he'd been promoted to general manager of Fairchild Semiconductor -- and with his new authority, he put physicist Jay Last to the task of figuring out how to build a commercial device.

Les Vadasz, Fairchild Semiconductor The devil is in the detail. The concept is one thing, the other thing is to make it work in a manufacturing environment where you can just turn out millions and millions of them.

Narrator: It took two years, but in March 1961, Fairchild introduced its first commercial integrated circuit, called Micrologic.

At $120, Micrologic was far out of reach for the average private company. But when President John F. Kennedy announced an ambitious new space program in May, it was clear that the federal government would be willing to pay for it.

President Kennedy (archival): "These are extraordinary times, and we face an extraordinary challenge. I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth."

Narrator: At a time when the average computer was a room-sized machine containing mile upon tangled mile of wires, Fairchild's integrated circuit -- or microchip -- made it possible to put a computer right on board a spacecraft and send it all the way to the moon.

Jack Yelverton, Fairchild Semiconductor: This was one of those really important disruptive technologies, that this was something that was going to change everything in electronics.

Leslie Berlin, Historian: Brilliant people with brilliant ideas exist all the time; it's just a question of being a brilliant person with a brilliant idea, in the right place at the right time, where people want what you've come up with.

Narrator: Fairchild landed the contract to supply chips for NASA's Apollo Guidance Computer. Meanwhile, other semiconductor manufacturers began to license Fairchild's technology and build integrated circuits based on the planar process.

By 1962, Fairchild Camera and Instrument was reporting the highest sales and earnings in its history -- and rival Texas Instruments was crying foul. TI filed suit against Fairchild for patent interference, claiming ownership of the integrated circuit concept.

Roger Borovoy, Fairchild Semiconductor: Texas Instruments said, "We think we invented that." Kilby certainly was first but Kilby's circuit was not a practical one.

Michael S. Malone, Writer: This is one of those cases of simultaneous invention. Kilby has time precedence, but Noyce's design is the one that worked.

Narrator: The suit would drag on for years. In the end, Fairchild and Texas Instruments would agree to share licensing of the integrated circuit.

By that time, TI itself was building microchips based on Fairchild's planar process technology.

Geri Hadley, Fairchild Semiconductor: I was driving down 101, and at the side of the road there was a large billboard with a sun rising, and it said something to the effect that Santa Clara County has more PhD's in high technology than any place in the world. And I, a light went off, it was an epiphany, and I said, "That's it. I'm going to go into high tech."

Narrator: Throughout the early 1960s, thousands of young men and women poured into the Santa Clara Valley every month, lured by the booming electronics and defense industries. And though each passing year brought new companies into being -- and with them, new jobs -- Fairchild Semiconductor was one of the Valley's biggest draws.

Les Vadasz, Fairchild Semiconductor: I was working at Transitron, and I really wanted to come to Fairchild because at that time that's where things were happening.

Jerry Sanders, Fairchild Semiconductor: The technology at Fairchild blew me away. To see what they were doing at Fairchild when I went there, I was in awe. These were the smartest people I'd ever met.

Narrator: Critical to Fairchild's appeal was the unique corporate culture that Robert Noyce encouraged.

Jack Yelverton, Fairchild Semiconductor: Bob had a very good idea of how the company should behave as a company. He had some pretty egalitarian ideas; he wanted to breakdown the distinctions between management and workforce.

Regis McKenna, Marketing Consultant: Bob managed by camaraderie. He believed in teamwork and, to him, everybody at Fairchild was part of the team.

Geri Hadley, Fairchild Semiconductor: It's what you could contribute that really counted the most. Everybody was highly competitive to do the best in their job, to make their company the best. Why would we work ten, 12-hour days? It wasn't because somebody told us we had to. We wanted to.

Charlie Sporck, Fairchild Semiconductor: We were bullish about where the electronics were gonna go. We did not have any hesitation about unlimited growth forever.

Michael S. Malone, Writer: The atmosphere of the early Fairchild was a combination of a college dormitory or frat house with, sort of like a country club locker room. It was basically a bunch of men in their 20s starting to make real money competing with each other on who had the bigger swagger. It either had to settle down and just become another company, or it had to blow up. It was just too volatile. It was just too much talent stuffed into one place.

Narrator: Even as it enjoyed its meteoric rise, Fairchild Semiconductor was beginning to unravel at its core.

By 1962, fully half of the founding team -- including Jay Last and Jean Hoerni -- as well as numerous researchers and engineers, had left the company to start new ventures -- most of them positioning themselves as direct competitors for the integrated circuit market.

Gordon Moore, Fairchild Semiconductor: It just exploded. Every time we came up with a new idea, we spawned two or three companies to try to exploit it.

Narrator: Over the next two decades, Fairchild would spin off more than a 100 new firms -- including Rheem, Signetics, Molectro, Amelco, General Microelectronics, Advanced Micro Devices. In the Santa Clara Valley, they were known as "Fairchildren."

Regis McKenna, Marketing Consultant: There was constant startups. Almost every company had employees coming out of Fairchild. They were educating people in this new era of silicon. As people began to develop their skills and knowledge, the whole idea of venture capital also was starting to grow and prosper.

Charlie Sporck, Fairchild Semiconductor: You knew how to build a product... 'cause you were doing it. It was strictly a matter of finding the money and taking the risk.

Michael S. Malone, Writer: In the Sixties at Fairchild, everybody looks out there and says, "Why are we sitting in the big city? We should be out there panning for gold. Let's go start our own chip company." Fairchild was like a seedpod, and it just scattered new companies all over this valley. And that's what really began what we think of as the modern Silicon Valley.

Narrator: By the mid-Sixties, Fairchild Semiconductor was raking in massive profits for parent Fairchild Camera and Instrument. In its first seven years, the semiconductor division had opened nine new manufacturing plants, including one in Hong Kong. And at a time when NASA was buying 60 percent of the integrated circuits produced in the United States, Fairchild was a major supplier -- shipping some 100,000 devices for the Apollo space program in 1964 alone.

Robert Noyce wasn't satisfied. It was all well and good to put Fairchild's microchips at the disposal of American astronauts -- but Noyce's real target was the American consumer.

Leslie Berlin, Historian: Noyce and his colleagues saw an expanse open in front of them, a world where electronics were getting faster, and smaller, and cheaper, and this could mean anything. Noyce just had this notion that this little thing that he had helped to invent was going to change the world.

Narrator: In the spring of 1965, Noyce made an announcement at an industry convention that stunned even his staff: Fairchild was slashing the price of its most popular integrated circuit.

The microchips would sell for just a dollar a piece -- less than what it cost a manufacturer to buy the components and assemble them.

What alarmed Noyce's team was that the price was also less than it cost Fairchild to make them.

Jack Yelverton, Fairchild Semiconductor: There's a principle that is pretty consistent in the electronics business that the first product that you make is very, very expensive. And each additional unit that you make brings the cost down just a little bit.

Gordon Moore, Fairchild Semiconductor: Bob was taking a risk that made us all gulp at the time, but it turned it out to be the proper solution.

Narrator: As Noyce expected, demand soared, production costs plummeted -- and before long, Fairchild was turning a healthy profit on commercial sales.

Les Vadasz, Fairchild Semiconductor: Bob Noyce always looked forward. I think he was confident in, with risk.

Regis McKenna, Marketing Consultant: Leaders break the rules. That's what they do. And I think he understood that principle. That whole cultural attitude of pushing the edges, of pushing the technology to where it's innovative and thinking about things that people hadn't thought before.

Geri Hadley, Fairchild Semiconductor: It was exciting. You know, our hearts and passions were really in our job. And we knew that this was a force that was just changing everything.

Narrator: Maybe it was the thrill that came from always hovering on the edge of discovery. Maybe it had to do with being on the literal edge of the country -- and a continent away from the old rules. But by the mid-1960s, the Santa Clara Valley was about as charged a place as any physicist or engineer could ever hope to find.

Michael S. Malone, Writer: We talk about the early era of Silicon Valley as being cowboys and Indians, and the Wild West show. And it really was.

Jerry Sanders, Fairchild Semiconductor: It was a wild time. People just drank too much. I just remember that three gin and tonics should've been my limit. And the bar of choice was the Wagon Wheel.

Charlie Sporck, Fairchild Semiconductor: We just got in the habit of going over there for a beer on the way home. Sometimes it was more than one.

Geri Hadley, Fairchild Semiconductor: It was very, very crowded. Everybody from presidents and CEOs down to line workers, and everything in between.

Charlie Sporck:, Fairchild Semiconductor It got to be a hangout not just for Fairchild people, but the spinoffs from Fairchild. I mean we all worked together even though we were competitors. We'd go in there and everybody was bragging about, "I took that job away from you down there at Hughes," you know. "You guys had it and I took it away." I mean it was just a marvelous environment of young guys having a good time competing with each other.

Jerry Sanders, Fairchild Semiconductor: Conversations were just rampant about the latest sputtering device, or the latest piece of epitaxial equipment. It was almost like a salon. You know, everybody talking about what was going on, who was working where, who was doing what.

Ginger Jenkins, Fairchild Semiconductor: You could make friends or lose friends at the Wagon Wheel. I mean it was a, a hub of networking.

Charlie Sporck, Fairchild Semiconductor: There were always a lot of girls from the factory there too, which is not all good.

Geri Hadley, Fairchild Semiconductor: There was a lot of hanky-panky going on. I remember thinking that the divorce rate was probably 150%, not just 100%, because a lot of the second marriages didn't make it either.

Jerry Sanders, Fairchild Semiconductor: We just all were very excited about building our business, building an industry. So there was a sense that we're all in it together. You know, and so what was good for one was good for all.

Michael S. Malone, Writer: Fairchild was one of a kind. They were hugely talented, they were first in, and they moved really, really fast. Motorola was chasing 'em, Texas Instruments was chasing 'em, the big companies like IBM with their microelectronics units were chasing 'em, and nobody could catch Fairchild 'cause they were just so creative and so brilliant. But, they were destined at some point to stumble, and the moment they stumbled everybody ran right over the top of 'em.

Narrator: In 1965, Fairchild Camera's stock rose faster than any other on the New York Stock Exchange. "All the excitement," TIME magazine reported, "is over one division, the Semiconductor branch."

Jack Yelverton, Fairchild Semiconductor: Fairchild Semiconductor really became the tail that wagged the dog. It produced most of the profits and all of the growth for Fairchild Camera.

Narrator: Increasingly, success bred discontent -- and a simmering resentment toward Fairchild's parent company.

At the top of the list of complaints was the fact that semiconductor profits did not get re-invested in the division's growth.

Jerry Sanders, Fairchild Semiconductor: As a result, companies like Texas Instruments, particularly, were catching up with Fairchild technology. As was Motorola, they were catching up. And so, with less funding for R&D and less funding for new plants and equipment, it was frustrating.

Michael S. Malone, Writer: These guys on the West Coast, they're looking at millions and millions of dollars being made, metaphorically being put into a Brinks truck and driven East, and they're not getting a piece of their success.

Narrator: For Noyce, it was a source of deep frustration. He had the power to direct the semiconductor division -- and the responsibility for its performance -- but no ability to reward his staff.

Jack Yelverton, Fairchild Semiconductor: We tried very hard to get Fairchild to think in terms of using more creative compensation, including the idea of a stock option program. They thought we were a bunch of dreamy-eyed socialists.

Narrator: Worst of all, in-fighting and a lack of communication between the R&D and manufacturing departments left the company scrambling to fulfill its orders.

Andy Grove, Intel: The research lab and the manufacturing location were seven miles apart. Those seven miles, from the standpoint of collaboration, could have been 7,000 miles.

Roger Borovoy, Fairchild Semiconductor Attorney: Things were not good. The company was floundering; products were very, very late. Bob was not a day-to-day manager by any stretch of the imagination. He knew that was not what he did well.

Andy Grove, Intel: I had nothing but unpleasant, discouraging dealings with him as I watched Bob manage a troubled company.

Michael S. Malone, Writer: I think one of the problems Fairchild got into was Noyce trusted people maybe too much, so that the company oftentimes became unharmonious.

Andy Grove, Intel: If two people argued and we all looked to him for a decision, he would put a pained look on his face and maybe said something like, "Maybe you should work that out." More often he didn't say that, he just changed the subject.

Charlie Sporck, Fairchild Semiconductor: Bob's biggest problem is he had great difficulty saying "no." If two department heads had different opinions as to what they wanted to do, it was whoever was there last got the right decision, 'cause always gave you a "yes."

Narrator: As the internal strife mounted and earnings plunged, Fairchild began to splinter.

In March 1967, Noyce's right-hand man, Charlie Sporck, announced that he was leaving to head up a competitor -- National Semiconductor.

Michael S. Malone, Writer: That stunned Fairchild. And when Sporck left and went to National he began to raid Fairchild for talent, and these guys all started going to National and they were all getting stock options. And they were succeeding, that was the real eye-opener.

Charlie Sporck, National Semiconductor: You're not completely pleased with the corporate office, and you got these guys leaving and starting companies and, and the companies are running, working. You get a look around and look in the mirror and say, "Well, you know, how about you? What are you gonna do?" I know now that Bob was thinking the same thing.

Narrator: Gordon Moore, chemist and director of the R&D department, was the first to hear of Noyce's plans.

Gordon Moore, Fairchild Semiconductor: Bob came to me and said, "How 'bout starting a new company?" Well, my first reaction was, "Nah, I like it here." And then a couple of months

later he came back and said, "I'm leaving. How would you like to start a new company?" which put a whole different light on the thing.

Narrator: Noyce and Moore resigned from Fairchild in the summer of 1968. Noyce was forty; Moore, thirty-nine.

As Noyce put it in a letter to Sherman Fairchild, his aim was to "get close to advanced technology again" and to enjoy "more personal creative work in building a new product, a new technology, and a new organization."

Michael S. Malone, Writer: The history of Silicon Valley is people going to startups... leaving really nice jobs that pay really well, and taking this gigantic leap to see if they can make something important happen, be valuable, and in the long run... maybe even get rich. Noyce is the prototype of that. The Noyces of the world didn't get into this to have a job. They got into this to create a reality, and to be in control of that reality. Even if it meant giving everything up and starting from scratch again.

Narrator: The images captivated the world. On July 20th, 1969 -- 12 years after the Russians had shamed America with Sputnik and just eight after President Kennedy had challenged the nation to "go to the moon" -- there was astronaut Neil Armstrong, stepping onto the lunar surface.

Neil Armstrong (archival): "That's one small step for man... one giant leap for mankind..."

Narrator: The scale of the achievement was obvious. What was less apparent to the half a billion people watching was that the success of Apollo 11 had hinged on the integrated circuit technology invented by Fairchild.

Charlie Sporck, National Semiconductor: At the time of the moon landing I was in Paris, on a sales trip, and all of the TV stores had the TVs on, and there were pictures of the Americans

on the moon. It was a very great, peer-patriotic feeling as well as a feeling that it's our technology that's doing that. It was a good deal.

Michael S. Malone, Writer: Nineteen sixty-nine really is that miracle year in 20th century American history. It's the moon landing; it's Woodstock. At the time we thought, "Wow, these are epochal events taking place around us and we're here for it." And even while they were battling over People's Park and rioting in the streets in San Francisco and protests at Stanford, what we weren't noticing just a few miles away were the guys sitting in laboratories inventing stuff that really did change the world, and will continue to change the world for centuries to come.

Narrator: By the time of the moonwalk, Robert Noyce and Gordon Moore had been in business a year.
Starting up had been a breeze. With their legendary status in the industry, they'd easily secured financing -- raising two and a half million dollars in less than two days.

They'd also managed to lure many of the best and brightest -- among them Andy Grove, a Hungarian-born chemical engineer who had joined Fairchild's R&D division in 1963. Now, he would serve alongside Noyce and Moore as the new venture's director of operations.

Andy Grove, Intel: Bob didn't know me well enough to have a real opinion. But Bob trusted Gordon, and Gordon thought I was pretty good.

Michael S. Malone, Writer: The smartest hiring I think Bob ever did in his life was hiring Andy Grove, because as good as the fit was between Noyce and Moore there was one thing lacking, and that was that drive to make the company function at its highest capability on a day-to-day basis. Neither one of those guys was tough enough for that job.

Ann Bowers, Intel: Andy was the guy who made sure the trains all ran on time. He was a taskmaster. He had very strong views about what you should do and what you shouldn't do and he was very direct about that.

Narrator: They'd called their new company "Intel" -- an abbreviation of "integrated electronics" which also happened to conjure the word "intelligence."

Regis McKenna, Marketing Consultant: It did not get a great deal of attention in the media, but there was just a buzz, particularly here in the valley. There was an expectation that they were gonna do something that was unique and different.

Narrator: Believing computers to be the future of the semiconductor industry, Noyce and Moore had decided to produce memory devices -- and to challenge the dominant technology, magnetic core memory, with a product based on Noyce's integrated circuit.

They'd given themselves two years to make a profit -- and the clock was ticking.

Andy Grove, Intel: I had horrible nightmares. Do all this with a ragtag crew that never worked with each other, run by somebody who never ran things like this. I never took a business course. I was inventing what to do as we went along. This was not easy.

Narrator: Those first years, Noyce would later say, were like "walking the thin line next to the cliff of disaster."

Noyce found it exhilarating. His mantra now was innovation, and everything about Intel had been designed to encourage it -- from the company-wide stock options to the open-plan office.

Michael S. Malone, Writer: And I remember walking in at Intel headquarters, and I couldn't find Noyce. A secretary had to come out and lead me to his cubicle, because his cubicle was almost indistinguishable from all the other cubicles in this vast prairie dog town of cubicles.

Here's the living legend, but he looked like a middle manager at a division of some Midwestern manufacturing company.

Ann Bowers, Intel: At Intel, there were no privileges anywhere. We started a form of company culture that was completely different than anything had been before. You worked hard and delivered, and that improved your life in a variety of ways. It was a culture of meritocracy.

Narrator: For Noyce, Intel was an answer to years of chafing at the strictures of corporate life -- from his experiences at Philco and Shockley Laboratories, to his dealings with Fairchild's parent company.

Ted Hoff, Intel: The idea is people should not have to go up through a chain of command. If you need to talk to a particular manager you go to him and you talk to him. To get away from the hierarchy that was characteristic of really large corporations where everything has to be done, you know, in a very rigid manner. That very democratic society was something that Bob promoted. And then Andy found a way to keep it, but keep it with discipline.

Michael S. Malone, Writer: The guys at the top, especially Noyce, trusted the wisdom of all the employees in the company. In their minds innovation could come from anywhere, and they were open to it coming from everywhere.

Narrator: In the spring of 1969, as Intel engineers continued to tinker with the design of their memory chip, the fledgling company scored a contract that would alter its course. The Japanese firm Busicom hired Intel to design 12 specialized microchips for its new calculator -- and almost immediately a young engineer named Ted Hoff raised a red flag.

Ted Hoff, Intel: The more I learned about this design, the more concerned I became that Intel may have undertaken more than it was prepared to deliver. The number of chips and their complexity was much greater than I had expected. And Bob said, "Well, if there's anything you can think of to simplify the design, why don't you pursue it."

Leslie Berlin, Historian: Noyce always encouraged the people in his labs to run with their ideas and see where they went.

Narrator: Hoff's concept was radical; he envisioned a single chip that could be programmed for a specific application -- in this instance, to function as a calculator.

Noyce saw the potential for much more. With Hoff's chip, the guts of a computer -- a machine that in 1969 was still more or less the size of a refrigerator -- could be shrunk down to fit on a fingertip.

Narrator: With a push from Noyce, Hoff's invention would lead directly to the world's first microprocessor -- Intel's 4004. Introduced in 1971, and containing more than 2,000 transistors, the device was advertised as a "computer on a chip."

The digital revolution had officially begun.

Jerry Sanders, Advanced Micro Devices: Probably the most important invention of the last 100 years was the microprocessor, which is basically the fundamental driving force and brain of all of the digital equipment we use today. Whether it's an iPhone, a computer, you know, a notebook, you know, a tablet -- whatever it is basically it's built around a microprocessor.

Michael S. Malone, Writer: That's the defining product of the modern world. There's never been a proliferation of a new technology that fast in human history.

Gordon Moore, Intel: It's been successful beyond anything we possibly have imagined in the beginning. And the result has really revolutionized the way people live.

Jerry Sanders, Advanced Micro Devices: The microprocessor is now a $100 billion industry and underlies the entire information technology world. The microprocessor of course is a collection of thousands, hundreds of thousands, now millions, of transistors. There's no way that those would've been possible without Bob Noyce's invention of the integrated circuit.

Michael S. Malone, Writer: I think you can credit Bob Noyce for being the first technology entrepreneur CEO, in the sense that he built a company that was wholly dedicated to being on the absolute cutting edge of technology... perpetually. The zenith of that is probably Apple Computer in the 21st century. The prototype for that is Intel in the 1960's and Seventies, where you build a company that is purely technology driven. You're not even sure what industries you're gonna be building for after a certain point. You're just driving the technology forward at breakneck pace and seeing what emerges from it all and then coping with it. It's a very, very interesting business model that never existed before and really begins with Intel.

Narrator: By the time Intel introduced the microprocessor, the Santa Clara Valley bore little resemblance to the verdant farmland it had been 15 years earlier when William Shockley set up shop.
The number of high-technology jobs in the area had increased ten-fold since 1959, and the population of San Jose -- the valley's largest city -- had more than doubled, to nearly half a million. As consumer applications for the microprocessor began to proliferate, venture capitalists rushed in -- gradually replacing the military and NASA as the financial backbone of the industry.

No longer would the area be referred to as the "Valley of Heart's Delight." After 1971 -- that banner year for Intel -- it would increasingly be known as "*Silicon* Valley" -- a name soon to be synonymous with risk, technological innovation, and a new brand of the American Dream.

Michael S. Malone, Writer: This Valley is perpetually young. It's always made up of the next generation of bright young entrepreneurs showing up, having their killing Dad moment of the

previous generation of Valley executives, and they start their own companies. We're not real big on history around here. We don't look back very much.

Jerry Sanders, Advanced Micro Devices: In Silicon Valley, innovation is everything. How are you different? How are you better? The rest of it is gut-busting, hard working engineering. But the idea to do something so different; that's the magic of Silicon Valley then and now.

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