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"The Genesis of a Technological Valley"

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INTRODUCTION

While researching the decline of industrial and family farms in the Santa Clara Valley, I became interested in one of the causes of that decline, the rise of high-technology. Having read several documents about some of the major high-technological firms in the valley I decided to gear my research towards the beginnings of "Silicon Valley." After having researched my topic I found it impossible to include all the events which caused the Santa Clara Valley to become a technological magnet, I decided to focus my paper on how the influences of Stanford University, Fred Terman, Hewlett-Packard, William Shockley, and Fairchild helped lead to the genesis of "Silicon Valley."

"The Genesis of a Technological Valley"

"While much of Santa Clara Valley was still covered with orchards and grazing cattle, technology was already beginning to shape its future and the future of much of California."¹ Though known for its agricultural products, Santa Clara County would become known as the electronics capital of the world. In 1912, a critical event took place. This event compounded with the dream of one man, Fred Terman, to create a center for electronics research development, led to the beginnings of the electronics industry in the County. Then Stanford University Vice President, Terman directly influenced the launching of Hewlett-Packard, one the area's largest electronics firms. With the success of Hewlett-Packard, Stanford University administrators hoped to lure electronics researchers to the area. To achieve this goal, they opened The Stanford Research Park. Slowly the area in and around Santa Clara County began to house more and more electronics firms. By 1971, the Santa Clara area became known as "The Silicon Valley."

No doubt the opening of Leland Stanford Junior University, in October of 1891, would later represent the beginning of Silicon Valley. "If there is a single moment that can be said to be the genesis of Silicon Valley, however unintentional, it probably occurred in Leland

¹Carolyn Caddes, Portraits of Success: Impressions of Silicon Valley Pioneers (Palo Alto, California: Tioga Publishing Company, 1986), p. 1.

Stanford's dream-racked sleep."² While the Santa Clara Valley had become known for its fruit production and the valley teemed with orchards, Leland Stanford decided to open a University on his Palo Alto farm in honor of his late son, Leland Stanford Jr. Leland aspired that the University would become the Harvard of the West, but back East the idea of a great university beyond the Rockies, located on a farm, received little more than sneers.³ No one had any idea, least of all Leland, that the University would influence a major change of industry in the Valley.

Though the University grew little between 1891 and the 1940s a critical event in electronics history took place in 1912.

In the Summer of 1912, in a small house at 913 Emerson Street in Palo Alto, Lee de Forest and two fellow researchers for the Federal Telegraph Company, an early electronics firm, leaned over to watch a housefly walk across a sheet of paper. They heard the fly's footsteps amplified 120 times. This event was the first time that a vacuum tube had amplified a signal; it marked the birth of electronics and opened the door for the development of radio, television, radar, tape recorders, and computers.⁴

Like many other electronics pioneers, Lee de Forest had a

²Thomas Mahon, Charged Bodies: People, Power, and Paradox in Silicon Valley (New York: The New American Library of Canada, Limited, 1985), p. 135.

³Ibid.

⁴Everett M. Rogers and Judith K. Larsen, Silicon Valley Fever: Growth of High-Technology Culture (New York: Basic Books, Inc., 1984), p. 30.

Stanford University connection. De Forest received partial finance for his work from Stanford officials and faculty. Many of the early Palo Alto engineers graduated from Stanford and worked for local electronics firms. They shared a common feeling of inferiority to the big East Coast electronics firms and, in comparison to the Eastern universities, Stanford remained a young upstart.⁵ Stanford's reputation would eventually change into that of a prestigious place of higher learning and research and development.

With the help of a visionary vice president, Frederick Terman, Stanford University became an integral part of what would become known as the Silicon Valley. "In 1920 Stanford was just a minor league, country-club school. By 1960 it had risen to the front ranks of academic excellence."⁶ Directly influencing the rise of Silicon Valley, Terman helped begin Hewlett-Packard, one of the valley's most prestigious electronics firms.

Having learned that two of his electrical engineering students, David Packard and William R. Hewlett, planned to start their own electronics business after graduation, Terman encouraged their entrepreneurship. Graduating in 1934, Packard went to work for General Electric in New York and Hewlett went to MIT for graduate work. Four years

⁵Ibid.

⁶Ibid.

later, Terman arranged fellowships for Packard and Hewlett so they could return for a fifth year of study at Stanford and earn their electrical engineering degrees. Setting up shop in the garage behind their boarding house, Hewlett and Packard built electronics gadgets and did odd job work that Professor Terman sent their way. In 1938, while taking a graduate seminar from Professor Terman, Bill Hewlett came up with the project he would use for his master's thesis, to build and evaluate a variable frequency oscillator.⁷ When Hewlett finished his machine he found that it operated over a wider range of conditions and cost a fraction of the price of similar existing products. Believing the oscillator had commercial value, Terman encouraged Hewlett to market it.

With a loan from Terman and arrangements for a loan from a Palo Alto bank, Hewlett joined Packard in business. During their first year they received few orders, then they got their break. Walt Disney Studios wanted eight audio oscillators to produce the soundtrack for "Fantasia;" Hewlett and Packard had achieved their first big sale. By 1940, the new firm of Hewlett-Packard(H-P) had expanded its work space. By 1942, H-P had a work force of about one hundred and did nearly \$1 million in sales. Demand for electronics during World War II gave the fledgling company a boost, but the company grew very slowly. With only 200

⁷A variable frequency oscillator is an instrument used to produce an alternating current. Hewlett's oscillator was used to test music and public address amplifiers.

employees in 1950, twelve years after it had begun, H-P's growth reflected the slow rate of change in what would become the Silicon Valley.⁸

Because the electronics industry grew slowly in the Valley, Stanford administrators found that after graduation many of their talented engineers tended to leave the area to get jobs with large electronics firms back East. Besides losing their best engineering students, Stanford's administrators also had to find a way to make money off University land without selling it, which the original Stanford family's gift of land forbade. Attacking both problems at once, Fred Terman, with the help of the university's president, came up with the idea of a high-technology industrial park. "The idea of an industrial park near a university was completely foreign."⁹ Leases for space within the park, which opened in 1951, raised University revenue and slowly electronics firms began to draw more and more to the area.

Many new electronics entrepreneurs began to move to the area. William Shockley, co-inventor of the transistor,¹⁰

⁸Everett M. Rogers and Judith K. Larsen, Silicon Valley Fever: Growth of High-Technology Culture (New York: Basic Books, Inc., 1984), p. 32-33.

⁹Ibid, p. 38.

¹⁰An important discovery, the transistor like the vacuum tube allowed for the magnification of electronic messages, but unlike the tubes it required less current, it did not generate a lot of heat, and it was much smaller.

decided to begin a semiconductor business. "Shockley knew what was getting underway in Silicon Valley through his many contacts in the electronics industry."¹¹ In 1955, he chose to locate in the Santa Clara Valley.

Although invented in 1947, manufacture of a reliable transistor proved a difficult task and the first commercial use did not begin until 1952. Soon after, in 1956, transistor technology advanced and Shockley received the Nobel Prize for his co-invention of the transistor. With help from one of his former professors from California Institute of Technology, Shockley started his own company called Shockley Semiconductor Laboratories. The professor, Arnold Beckman, a manufacturer of scientific measurement equipment, had located a division of his company, Beckman Industries, at the Stanford Research Park. Beckman provided financing, while Shockley vigorously recruited eight intelligent young men from laboratories on the East Coast.¹²

. . .when Shockley's first hand picked employees began arriving in Palo Alto, they found a closely knit community of scientists, in the shadow of Stanford University, who were grappling with the new challenges of semiconductor electronics. The broad brown run of the valley to the south was filled with fruit trees, and nearby Santa Clara and San Jose were better known for orchards than for

¹¹"Everett M. Rogers and Judith K. Larsen, Silicon Valley Fever: Growth of High-Technology Culture (New York: Basic Books, Inc., 1984), p. 37.

¹²Ibid.

electronic sorcery. Still, something new was quite evidently in the air.¹³

The eight young men Shockley recruited would become influential in forming a semiconductor industry on the West Coast.

Unable to maintain a good working relationship with his eight young employees, Shockley watched seven of the eight detach themselves from his company and form their own West Coast semiconductor company. Looking for start up money, the seven men came across an investment firm called Hayden Stone. Fortunately Hayden Stone had ties with an East Coast company called Fairchild Camera and Instrument. Fairchild's president, John Carter, having served on several government boards during World War II, had become familiar with the research taking place in the transistor industry and he wanted to buy into the new industry. The seven defectors from Shockley's company developed a strong business plan for a new semiconductor manufacturing company. Looking to strengthen their case even more, the seven recruited an eighth, one of Shockley's young physicists, Robert Noyce.¹⁴ "People naturally gravitated towards Noyce. He had an effortless way of taking charge that marked him as a competent future manager"¹⁵ Noyce, known for his

¹³Dirk Hanson, The New Alchemists: Silicon Valley and the Microelectronics Revolution (Boston: Little, Brown and Company, 1982), p. 88.

¹⁴Ibid, p. 90.

¹⁵Ibid, p. 91.

mild manner and team player spirit, completed the group.

In 1957, not long after Noyce joined the seven defectors, the financing worked out and Fairchild Semiconductors opened in Mountain View, California, a few miles away from Palo Alto. "It was the beginning of an entrepreneurial flourish in this valley. Suddenly it became apparent to people . . . , who had always assumed they would be working for salary for the rest of their lives, that they could get some equity in a start-up company."¹⁶ Fairchild flowed with the entrepreneurial wave and began development of the integrated circuit.¹⁷

With the Soviet launching of Sputnik in 1957, the military encouraged development of electronic miniaturization; a smaller circuit weighed less and cost less to send into space. In 1959, Jean Hoerni, one of the original eight who started Fairchild, developed a new, cheaper process for manufacturing integrated circuits called the planar process.¹⁸ As technological research

¹⁶Ibid, p. 91-92.

¹⁷An integrated circuit is an electronic device in which all the circuit elements (such as transistors, diodes, resistors and capacitors) are contained and interconnected on a single semiconductor die (chip) instead of having separate components wired together. Integrated circuits are much faster, more reliable, and cheaper to build than circuits made with discrete components; Carolyn Caddes, Portraits of Success: Impressions of Silicon Valley Pioneers (Palo Alto, California: Tioga Publishing Company, 1986), p. 132.

¹⁸The planar process interconnected several tiny transistors and other components on silicon during the manufacturing process of the chips. A commercial breakthrough, it cut costs because the

expanded, Santa Clara County grew.

Spin-out companies and new corporations sprung up all around the Valley. Rheem Semiconductors, founded by Fairchild's former general manager, never got off the ground; it later became Raytheon Semiconductor in 1961. Other Fairchilders started their own businesses, such as Signetics Corporation, Teledyne Semiconductors, and General Microelectronics.¹⁹ By the 1960s, Santa Clara County's main economic draw came from the electronics industry. Palo Alto alone housed four of the county's largest companies--Lockheed, Philco-Ford, Varian, and Hewlett-Packard. By the mid-1960s, the cities of Mountain View and Sunnyvale, both in Santa Clara County, housed more than 130 companies, most of which dealt in the electronics field.²⁰ In 1963, a survey of fifty-three companies showed that pleasant climate and good living conditions in the area ranked high on reasons to come to the Valley; the availability of brain power in the form of engineers and the proximity to

transistors and circuit elements did not have to be but apart and wired back together again; Ibid, p. 133.

¹⁹Dirk Hanson, The New Alchemists: Silicon valley and the Microelectronics Revolution (Boston: Little, Brown and Company, 1982), p. 101.

²⁰Stephen M. Payne, Santa Clara County: Harvest of Change (Northridge, California: Windsor Publications, Inc., 1987), p. 125.

universities also ranked high.²¹ While a good environment fostered electronic growth so did the availability of money.

By the 1960s, California received more federal defense money than any other state. Continuous construction of new businesses occurred. Already established companies often expanded their operations within the Valley. By 1960, 807 industrial plants existed in the county. The Santa Clara Planning Department estimated that one industrial job with the county brought eight to ten new residents and 1.5 new non-manufacturing jobs. Companies swallowed up land quickly by building large plants. In 1940, farm lands claimed by the county reached 101,666 acres and in 1973 only 23,511 acres remained.

Friendly local government and business environments also contributed to Santa Clara County's growth. The federal government made the possibility of owning a home more likely by providing low interest loans. Both federal and state government aided with water, sewage, and airport development funds. Development of highways 101, 17, 280, and 680 opened up new areas in the county to electronics development.²²

Although most of the Valley's electronics industry

²¹Everett M. Rogers and Judith K. Larsen, Silicon Valley Fever: Growth of High-Technology Culture (New York: Basic Books, Inc., 1984), p. 39.

²²Stephen M. Payne, Santa Clara County: Harvest of Change (Northridge, California: Windsor Publications, Inc., 1987), pp. 175-179.

began in Palo Alto, the hundreds of spin-off firms expanded throughout the area. Fairchild, a breeding ground for spin-off companies, had broken away from Shockley Semiconductor Laboratories in Palo Alto and formed in Mountain View. A few miles away, further down the Valley, a large concentration of semiconductor firms sprang up in Sunnyvale, Cupertino, and Santa Clara. The county that had been known as the prune capital of America in 1950 began to become the electronics capital of the world. The area in and around Santa Clara County eventually became known as "The Silicon Valley."

In 1971, Don C. Hoefler coined the name "Silicon Valley." Hoefler, editing a weekly semiconductor industry news sheet called Microelectronics News, chose the name because it sounded cute and it made sense. Semiconductor chips made of silicon had become the fundamental product of local high-technological industries, and although the area, in the strict geographical sense, did not form a valley, most of the semiconductor firms had located their plants on level ground bounded on opposite sides by the San Francisco Bay and by a range of hills. The name became widely used and the Santa Clara County area became known as "The Silicon Valley."²³ The technological Valley had finally become known around the world and many people wondered how come the

²³Everett M. Rogers and Judith K. Larsen, Silicon Valley Fever: Growth of High-Technology Culture (New York: Basic Books, Inc., 1984), pp. 25-28.

electronics industry had started in "The Silicon Valley."

Consider a spring morning back in 1913 in Palo Alto. On Emerson Street a forty-year-old Lee de Forest and his colleagues are working to find new applications for the vacuum tube. On Bryant Street, teenaged Varian brothers are, as usual for them, tinkering away. Nearby, a thirteen-year-old Fred Terman is sending and receiving messages on his crystal set. And on Waverly Street, a three-year-old William Shockley moves into a new home as his father takes up a teaching position at Stanford. And all the while, the air is fragrant with the smell of orchards in bloom.²⁴

With the collective genius of just five men like de Forest, the Varian Brothers, Terman, and Shockley, all located in one area, something magnanimous would have to result. The location of Stanford University in the orchard valley greatly aided the development of electronics research in the area. Fred Terman's development of The Stanford Research Park and his influence in launching one of the first, greatly successful electronics companies, Hewlett-Packard, began a wave of industrial change in the area. Hewlett-Packard's success helped lure electronics researchers like William Shockley back to the area and bring many more new researchers to the area. By inventing the transistor, Shockley began the race to find the fastest, smallest, most reliable, and cheapest way to manufacture a circuit. With the beginnings of the semiconductor age, the pace of electronics research picked up and more and more people

²⁴Thomas Mahon, Charged Bodies: People, Power, and Paradox in Silicon Valley (New York: The New American Library of Canada, Limited, 1985), p. 162.

began to come to "The Silicon Valley" and many became entrepreneurs, starting their own companies. Once known for its orchards, growth of the high-tech industry changed the Santa Clara Valley into a technological giant.

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