Apollo 11 to the Moon:

Sherman M. Fairchild's Legacy to Space and Beyond

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At the Inflection Point

By 1957, the former Oneontan Sherman Mills Fairchild, was described as " a meticulous man in his 60's who frequented New York's posh 21 Club and wore 'a fresh pretty girl every few days like a new boutonniere'".[i] He was about to invest in semiconductors at a point where their use in place of the old vacuum tube was exploding in all phases of consumer and defense electronics because they did the same jobs in a smaller, lighter, more robust package with vastly less usage of power and longer life. Examples of semiconductors are the transistor and the diode. They are made of inexpensive elements like silicon doped with slightly more expensive but small quantities of rare earth elements. The transistor is a device that, depending on its use in a circuit, can operate as a switch with two electrical states, like 0 and 5 volts. Thus, its use in computers is obvious. It can also be used as the active element in an amplifier circuit. The 1956 Nobel Prize in Physics was awarded to its inventors, William Bradford Shockley, John Bardeen, and Walter Houser Brattain of Bell Telephone Labs.[ii]

It must be stated that aside from their use in portable radios, TV's, and stereos, the transistor had a much more serious impact on national defense by enabling computers to be miniaturized. The launching of *Sputnik* in 1957 had proved that the USSR had the ability to attack The United States homeland with nuclear-tipped intercontinental ballistic missiles. Responding by building our own versions of these missiles made computer miniaturization imperative so that they could fit in the warheads to provide control and guidance.

The architecture of stored program computers, from the time when they were first built following WW2 until the latest tablet, has remained for the most part invariant. You have the central processing unit (CPU), the memory device (magnetic cores, memory chips, magnetic cards), and the Input/Output (I/O)

(punched cards, cathode ray tubes, flat displays, touchscreens). All have benefitted from the semiconductor revolution but none so much as the CPU. By 1957 most were made from tube logic but some designs, particularly for the military, were beginning to use discrete transistor logic.

A Place called Silicon Valley

By 1957 William Shockley had created Shockley Transistor Laboratories with the avowed goals of building transistors using silicon substrates and the process of diffusion, where a semiconductor is cooked in an oven containing appropriate impurities that then seep into the semiconductor like hickory flavor seeps into meat cooked in a barbecue pit.[iii] As staff, Shockley had carefully assembled in 1956 eight men under 30 with complementary skills in physics, metallurgy, chemistry and electrical and chemical engineering: Their names and expertise bear recording: Jean Hoerni , Jay Last, Robert Noyce (physicists); Gordon Moore (physical chemist), Victor Grinich (electrical engineer), Eugene Kleiner (industrial engineer) , Sheldon Roberts (metallurgist), and Jay Blank (mechanical engineer).[iv] Their heads were filled with ideas concerning silicon transistors, the electronic switches that are the building blocks of computers.[v] Now computers are designed using logic diagrams just as a house is built using a blueprint. A basic set of logic elements is required to built a computer. The elements can be built out of transistors which are combined in electrical circuits to achieve certain functions.

Shockley was difficult to work with and was constantly redirecting his team to changed goals. In September 1957 the staff of 8 resigned en mass and founded what became Fairchild Semiconductor in Palo Alto, California. Arthur Rock, a security analyst at the New York investment bank Hayden Stone, and his boss Arthur Coyle had canvassed more than 30 potential corporate investors before attracting Sherman Fairchild, founder and chairman of Fairchild Camera and Instruments .[vi] One of the first West Coast venture capital deals was negotiated, where Fairchild loaned the founders $1.38M in exchange for the right to purchase the company if it succeeded.[vii] Now Noyce and his team were free to pursue their own destiny. Robert Noyce obtained a patent for the integrated circuit in 1959. [viii] To quote Gordon Moore, "The computer that went to the moon with the Apollo astronauts was built using the three input NOR gate from the (Fairchild)

Micrologic family of circuits."[ix] No Apollo Guidance Computer, one each on the Command and Lunar Modules, ever experienced a hardware failure during a mission.[x]

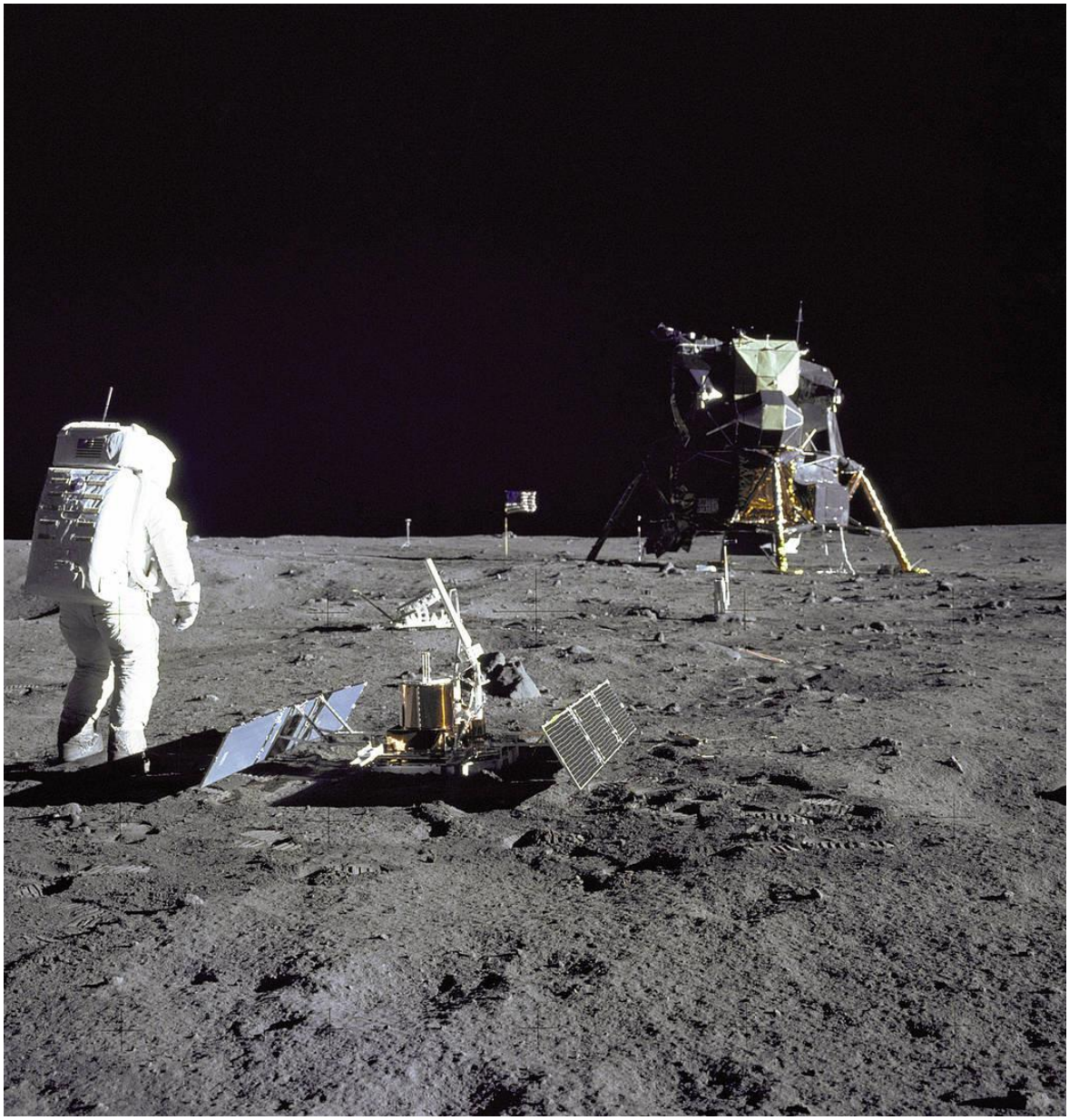

Image Credit: NASA

Coda

The success of Fairchild Semiconductors was relatively short lived. Eventually Fairchild Instrument and Camera (FCI) exercised its option of purchasing the shares of Semiconductor and recasting it as a division of FCI. Largely on the

strength of its fast growing Semiconductor division, by 1961 FCI had record sales ($92 million) and profits ($3.8 million).[xi] However, in many areas, internal dissention in Semiconductor was on the rise. Devices that worked in the R&D Lab in Palo Alto often failed to perform the same way after they left the production line in Mountain View, possibly due to contamination. Innumerable meetings between the two groups provoked frustration. This frustration led to spinoffs. By 1961, 4 of the original firm's founders had left to begin their own firms.[xii] Buoyed by a booming '60s stock market, spinoffs could attract capital easily.[xiii] The CEO John Carter of FCI expanded into many products like graphic arts, oscilloscopes, and home movie equipment all of which were unsuccessful but depended on Semiconductor profits.[xiv]

Noyce served as general manager of Semiconductor. He was assisted by Charles Sporck (originally from GE), head of manufacturing who in time built an operation that guaranteed cleanliness and product control. In 1965, Noyce was named a vice president of FCI and began to spend most of his time in Clifton, New Jersey running a new Instrumentation Division. Sporck took over as general manager, but his innovation of assigning product managers to coordinate production of each specific device came too late.[xv] By the end of 1966, Semiconductor began to miss deliveries. In the 4th quarter FCI profits dropped from the previous quarter. A source of resentment was a five-year cost reduction plan for Semiconductor which was adopted despite the persistent waste of money by FCI over the years.[xvi] In March 1967 a disgusted Sporck took several key integrated circuit men with him as he became CEO of National Semiconductor. By this time Noyce, a highly creative man who was spending all his time fending off FCI's unwanted acquisitions and fighting to keep key employees, was beginning to consider leaving Semiconductor. FCI's earnings for the third quarter slid to $137000, down 95.5 % from the preceding year's third quarter profit of $3 million. By year's end, FCI reported a $7.7 million loss.[xvii] Noyce announced his formal resignation from Fairchild on June 25, 1968. In a two-page letter to Sherman Fairchild, Noyce said that he wanted to start a smaller company where he could get close to advanced technology again and enjoy more personal creative work in building a new technology, product, and organization. [xviii]

The Events That Followed

A month later Robert Noyce and Gordon Moore established N-M Electronics, a semiconductor memory company they soon renamed Intel.[xix] On July 24, 1969, Apollo 11 successfully completed its mission to the moon and back using two onboard guidance computers based on integrated circuits designed by Fairchild Semiconductor. Before he died on March 28, 1971, Sherman Fairchild was formally recognized at the Smithsonian Institution for his 50 years in the aviation industry. He gave the Smithsonian a full set of scale models of his aircraft.[xx] The set should have included the Apollo 11 lunar module Eagle and command module Columbia, of whose accomplishments Fairchild must have been aware. A good dancer with an eye for pretty girls, he enjoyed entertaining the most stunning models at his Long Island estate, always chaperoned by his Aunt May. Geoffrey Hellman wrote in the New Yorker in 1941: "He approaches girls neither frivolously or romantically, but with the detached, spotty interest of a bachelor taking a half-hour off to buy a lampshade".[xxi]

And finally, an exhibit at the Computer History Museum in Mountain View, California discusses the impact of the Fairchildren. These are companies tracing their origins to founders and employees of Fairchild Semiconductor. As of 2014, ninety-two companies in the Bay Area qualify as Fairchildren, with a total market value exceeding $2 trillion.[xxii] Oneonta, where Sherman Fairchild grew up, can be proud.

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[i] Berlin, Leslie R., *Robert Noyce and Fairchild Semiconductor, 1957-1968,* The Business History Review, Vol 75, No 1. Computers and Communications Networks(Spring,2001), p. 74.

[ii] See the Nobel Prize website https//www.nobelprize.org/prizes/lists/all-nobel-prizes-In-physics/.

[iii] Berlin, p 69.

[iv]Moore, Gordon E. *The Role of Fairchild in Silicon Technology in the Early Days of "Silicon Valley",* Proceedings of the IEEE, Vol. 86, No. 1, January , 1998. p. 53.

[v] To see a brilliant video, Google "Veritasium How a transistor works". To see how transistors are combined to perform basic logic functions (or gates) like NOT, NAND, NOR, Google "Boston University From Transistors to Gates".

[vi] Laws, David A., *A Company of Legend: The Legacy of Fairchild Semiconductor,* IEEE Annals of the History of Computing January-March 2010. p. 63.
[vii] Ibid.
[viii] Berlin, p. 79.
[ix] Moore, p 59.
[x] Google "National Air and Space Museum Apollo Guidance Computer and the First Silicon Chips". See end of 3rd paragraph.
[xi] Berlin, p.81.
[xii] Berlin, p.84.
[xiii] Berlin, p.84.
[xiv] Berlin, pp. 85-86.
[xv] Berlin, pp. 92-93.
[xvi] Berlin, p.93=94.
[xvii] Berlin, p. 96.
[xviii] Berlin, p. 98.
[xix] Berlin, pp. 98-99.
[xx] Obituary, *Sherman Mills Fairchild is Dead at 74; IBM Heir Invented an Aerial Camera*, New York Times, (March 29, 1971)
[xxi] Ibid.
[xxii] Computer History Museum website: https://computerhistory.org/stories/spinoff-fairchild/.