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A Diversified Portfolio: Resources Fueling Silicon Valley Before Venture Capital

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How did Silicon Valley gather and deploy resources toward innovation and entrepreneurship before the 1959 arrival of the region's first venture capital firm? The growth of the U.S. military and accumulation of American wealth from the second industrial revolution enabled the flow of resources to the Valley. Defense contracts provided much-needed revenue, collateral for loans, and funding for university laboratories. Capital from earlier industrial activity provided the region with key resources through satellite operations of distant firms, loans from San Francisco financial institutions to local start-ups, and grants from American foundations for university activities.

In this paper, I demonstrate the Valley's process of attracting resources by examining the cases of three organizations. First, I summarize the transfer of resources from federal government agencies and private foundations funded by Gilded Age wealth to Stanford University, the region's academic anchor. I then show how resources flowed through government contracts and bank loans (enabled by California's system of branch banking) to the Valley's two largest indigenous firms of the 1950s: Hewlett-Packard and Varian Associates. I also show how, before the establishment of their company, the Varian team had been supported by the resources of the New York-based Sperry Gyroscope Company.

In 1959, Soviet premier Nikita Khrushchev visited the United States and stopped at IBM's San Jose research facility, one of many outposts established by eastern corporations in the area we now call Silicon Valley. The following year, French president Charles De Gaulle made two stops

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in California: at Disneyland and Stanford Industrial Park (now called Stanford Research Park).[1] By the time of these state visits, Silicon Valley had more than 100 high-tech firms.[2] Yet 1959 was the founding year of Draper, Gaither, and Associates, the Valley's first venture capital firm. Where did resources for tech come from before venture capital arrived in the world's foremost high-tech entrepreneurial region?

One of Silicon Valley's most significant endowments was its location in the United States at the moment the U.S. was using its wealth to project political and military power on the world stage. Silicon Valley came to be in the country with the world's largest economy as it was developing the world's most formidable system of national defense and associated technological capabilities. Silicon Valley came to be in one of America's wealthiest states. The Valley was just south of San Francisco, the largest financial center west of the Mississippi, where capital had been repurposed from the region's legacy industries of railroads, mining, oil, agriculture, and shipping.[3] Silicon Valley came to be in the country with the world's foremost system of research universities. Being located amidst national and regional wealth and near major research universities can work to a region's advantage, but does not guarantee sufficient inflow of resources to become Silicon Valley. Institutions—both nearby and afar—transferred resources to the Valley.

In this paper, I will show how government contracts brought revenue to local business and academic organizations. I will show how federal and state laws enabled the financing of local tech companies. I will show how access to resources of distant firms and foundations repurposed capital from earlier industrial activity, nourishing Silicon Valley's early development. I will summarize the transfer of resources to Stanford University, the region's academic anchor. I will then turn to the Valley's two largest indigenous firms of the 1950s, Hewlett-Packard (H-P) and Varian Associates. The experiences of Stanford, H-P and Varian reveal what was required, and what was possible, before the arrival of venture capital and high-tech law firms to Silicon Valley. I will conclude with an assessment of differences and similarities between the Silicon Valley of 1909-1959 and the Silicon Valley of the 21st century.

Resources from Washington

In December of 1957, less than three months after the Soviet launch of Sputnik, representatives of Valley electronics firms and other members of the region's tech ecosystem received an invitation from the Strategic Air Command for a briefing at Offut Air Force Base in Omaha, Nebraska, aimed at "leaders in the communications-electronics industry on the West Coast." Those invited to hear the latest on "America's long range atomic strike force" included heads of fifteen firms, including Ampex, Dalmo Victor, Eitel McCullough, Hewlett-Packard, Litton Industries, and Varian Associates. The invitation also included division heads of local

I benefited from comments regarding an earlier version of this paper at the September 21, 2017, seminar of the Johns Hopkins University Institute for Applied Economics and the Study of Business History.

[1] John M. Findlay, *Magic Lands: Western Cityscapes and Culture after 1940* (Berkeley, CA, 1992), 117.

[2] AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, MA, 1996), 208.

[3] Carey McWilliams, *California: The Great Exception* (Santa Barbara, 1976), 33, 218, 229-232.

operations of firms based elsewhere, such as General Electric, Lockheed, Sylvania, and IBM, as well as administrators from Stanford and the University of California, Berkeley.[4]

Such intimacy with the military was nothing new in the Valley. Before consumers began to snap up new video games and other consumer electronics, the Valley was blessed with what start-ups seek: motivated lead customers (the U.S. Navy, the U.S. Army, and the U.S. Air Force). The U.S. military's twentieth-century needs included cutting-edge capabilities in telecommunications (especially radio and radar), advanced instrumentation, and electrical components that would enhance systems capabilities.[5] Key companies in the Valley's history may have wanted to aim their products or services at businesses or consumers, but they first used government contracts to sustain them as they assembled competitive capabilities.

The original business model for the Federal Telegraph Company (FTC) in 1909 involved a commercial business that would compete in the United States with Western Union through one of the original promises of wireless telegraphy: a cheaper service made possible through cost reduction.[6] When that model did not provide a clear path to profitability, the company was saved by about $3 million of Navy contracts, beginning in 1913. Thanks to government work, Silicon Valley's first major high-tech firm remained a going concern for two decades before its acquisition by ITT. Thus began a pattern of relationships between Valley firms and the federal government.

In the 1950s, three Valley firms (electronics equipment maker Hewlett-Packard, founded in 1938; recording equipment maker Ampex, founded in 1944; and power tubes maker Varian Associates, founded in 1948) made initial public stock offerings. The 1950s also featured a 1953 blockbuster acquisition by an outside firm of tube maker Litton Industries (founded in 1945) and the founding of the Valley's first successful semiconductor firm (Fairchild Semiconductor, 1957). All five firms had defense agencies among their first major customers.

In addition to giving business to early stage firms, the federal government provided protections and incentives that might motivate inventors and entrepreneurs whose efforts might help national defense.[7] One way the government could assure a sufficient stable of contractors during a national emergency was through legal protection. High-tech commercial start-ups were ever vigilant about potential infringement suits filed by larger companies. In the 1930s, for instance, the San Carlos-based Dalmo Manufacturing Company declared bankruptcy after losing one such suit and then emerged as a defense contractor.[8] In a new incarnation, the Dalmo Victor Company was on firmer legal ground. In 1918, at the behest of Assistant Secretary of the Navy Franklin D. Roosevelt, Congress had decreed that patent infringement suits related to

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[4] Griswold to list, 20 December 1957. Charles Litton Papers (75-7), Box 3, Folder "G Miscellaneous," Bancroft Library.

[5] Kenneth Flamm, *Creating the Computer: Government, Industry, and High Technology* (Washington, D.C., 1988).

[6] Stephen B. Adams, "Arc of Empire: The Federal Telegraph Company, the U.S. Navy, and the Beginnings of Silicon Valley," *Business History Review* 91 (Summer 2017): 329-359; Susan J. Douglass, *Inventing American Broadcasting, 1899-1922* (Baltimore, MD, 1989).

[7] Martha L. Reiner, "The Transformation of Venture Capital: A History of Venture Capital Organizations in the United States (Ph.D. diss., University of California, Berkeley, 1989), 61.

[8] Timothy J. Sturgeon, "How Silicon Valley Came to Be," in *Understanding Silicon Valley*, ed. Martin Kenney (Stanford, CA, 2000), 42-43.

government contract activity would be directed against the government rather than against individual firms.[9]

The world of defense contracting also could include protection against foreign competition. Preference to domestic contractors amounted to a de facto tariff. The Federal Telegraph Company was a beneficiary of such protection against Great Britain's Marconi Wireless Company for six years before the 1919 creation of the American radio monopoly RCA.[10]

The U.S. government also protected what would become Silicon Valley's signature industry of semiconductors. A team headed by William Shockley at the Bell Telephone Laboratories of AT&T (a regulated monopoly) invented the transistor in late 1947. Not long afterward, the Justice Department sued AT&T, attempting to pry loose its captive manufacturer (Western Electric). In the early 1950s, with the suit still unresolved. Bell Labs disseminated its new transistor technology via a $25,000 licensing fee to twenty-five American firms. Then Western Electric showed them how to manufacture the devices.[11] Shockley himself seeded the Valley's signature industry in 1955 with the establishment of Shockley Semiconductor Laboratories.

Resources from American Industry

In 1994, AnnaLee Saxenian published *Regional Advantage*, which remains the most influential scholarly book about Silicon Valley. Saxenian asked how Silicon Valley overtook the Route 128 area outside of Boston as the world's leading high-tech region, and then provided two major explanations: contrasting cultures and different organizational forms.[12] Twenty-first century studies have shown that if the enterprises founded by MIT graduates were combined, the resulting agglomeration would rank as one of the world's top 20 economies, and that Stanford's agglomeration would rank a bit higher. Route 128, the "loser" in this competition, settled for being merely a top, not *the* top entrepreneurial high-tech region. I would pose another question: How did two such successful high-tech regions end up in the same country?

Scholars have made other comparisons: between the San Francisco Bay Area to Los Angeles; between Silicon Valley, Philadelphia, and Atlanta; between Silicon Valley/Route 128 and such "second tier" regions as Portland, Boise, and Kansas City; and between Silicon Valley of the early 21st century and Detroit of the early 20th century; or between Silicon Valley and Minneapolis, the Bronx, Fort Collins, Hartford, and Hollywood.[13] Hidden in plain sight are the tremendous opportunities accruing to location in the United States of the 20th Century.

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[9] J. Edward Welch, "Patent Infringement in Government Procurements: GAO's Role," *William & Mary Law Review* 10 (1968), 39-42.

[10] Adams, "Arc of Empire," 338-345.

[11] Michael Riordan and Lillian Hoddeson, *Crystal Fire: The Birth of the Information Age* (New York, 1997), 195-197; John E. Tilton, *International Diffusion of Technology: The Case of Semiconductors* (Washington, D.C., 1971), 73-77.

[12] Saxenian, *Regional Advantage*.

[13] Michael Storper et al., *The Rise and Fall of Urban Economies* (Stanford, CA, 2015); Margaret P. O'Mara, *Cities of Knowledge: Cold War Science and the Search for the Next Silicon Valley* (Princeton, NJ, 2005); Heike Mayer, *Entrepreneurship and Innovation in Second Tier Regions* (Cheltenham, England, 2011); Steven Klepper, "Silicon Valley: A Chip off the old Detroit Bloc," in *Entrepreneurship, Growth, and Public Policy*, eds. Zoltan Acs, David Audretsch, and Robert Strom (Cambridge, England, 2009), 79-115; Arthur P. Moella and Anna Karvellas, *Places of Invention* (Washington, D.C., 2015).

In the immediate aftermath of World War II, U.S. industry had no peer, especially in big business, as the multidivisional organization gained popularity.[14] Divisions of major U.S. tech firms brought the fruits of previous industrial activity to Silicon Valley, especially in the 1950s. Indeed, from about 1950 to 1980, a majority of the postwar tech jobs in the Valley belonged to employees of companies based elsewhere. The populating of the region with what we now call knowledge workers, with access to corporate resources and armed with training from within the organization (a luxury not provided by the usual start-up), was an invisible, but important contributor to the region's development. By 1959, divisions of Sylvania (Massachusetts), IBM (New York), Westinghouse (Pennsylvania), and Lockheed (southern California), were among the largest employers of the Valley.

Just like domestic direct investment, money from American foundations represented bounty from earlier or distant industrial activity. Whereas divisions of firms based elsewhere made an immediate impact on the local tech industry, foundation money made a less immediate contribution because it was channeled through universities. From 1920-1960, Stanford University received money repurposed from oil (Rockefeller Foundation), mining (Guggenheim Fund), and automobiles (Ford Foundation). Foundation money made a large indirect impact on the local aerospace industry, as well as a direct impact on the region's academic anchor.

Resources to the Suburbs

The third industrial revolution was a suburban phenomenon. Although the Stanford Industrial Park was a pioneer in university land use, a shift of what we now call knowledge industry from cities to suburbs was already well under way when the Park opened in 1951. Telecommunications giant AT&T had established a research facility in Whippany, New Jersey, and moved the Bell Telephone Laboratories from New York City to Murray Hill, New Jersey, and RCA had established a research center in Princeton. Similar moves were under way in chemicals and pharmaceuticals, moving white collar jobs out of New York and Philadelphia. The third industrial revolution's emphasis on brainpower also turned universities such as Stanford into magnets, pulling not just students but enterprise into its orbit.[15] California's banking laws and practices aided the tech industry's move to suburbia.

Until the 1970s, when venture capital firms moved to Menlo Park, the key source of capital was in San Francisco, which had been the financial center of the West since California's Gold Rush in the mid-nineteenth century. In the 20th century, the nexus of high-tech activity gradually headed south, attracted by developments at and around Stanford University, but still tethered to San Francisco's financial resources.[16]

Key tech firms founded prior to 1950 were all within relatively easy striking distance of San Francisco's financial district. Eitel McCullough (1934, San Bruno), Dalmo Victor Company and Ampex (both 1944, San Carlos), Litton Industries (1945, Redwood City) and Varian Associates (1948, San Carlos) were all within 45 minutes by car or train. Hewlett-Packard (1938), like the Federal Telegraph Company before it, was near a Palo Alto train station, within an hour of San Francisco. Company officials could spend the morning in the

[14] Alfred D. Chandler, *Strategy and Structure: Chapters in the History of American Enterprise* (Cambridge, MA, 1962).
[15] O'Mara, *Cities of Knowledge*.
[16] Stephen B. Adams, Dustin Chambers, and Michael Schultz, "A Moving Target: The Geographic Evolution of Silicon Valley," *Business History* 60 (6), 859-883.

office, and then meet with their bankers, lawyers, and accountants (all clustered within a couple of blocks of one another) in the afternoon.

Thanks to California's Banking Act of 1909, these firms did not need to make the half hour to one-hour trip to San Francisco often. Instead, thanks to branch banking, they had the best of both worlds: the ability to do most of their banking business in their headquarters town, while having access to far more funds when needed.

The Banking Act codified the ability of an urban bank—with state approval--to either create branches within the same city or elsewhere, or to acquire established banks and to deploy them as branches.[17] Within two decades of passage of the act, California became the nation's epicenter of branch banking. A 1932 report from the Federal Reserve Board indicated that "California is the only State in the Union in which modern intern-community branch banking has had a considerable development."[18] The proliferation of branch banking came at a fortuitous time for electronics start-ups on the Peninsula. During the 1950s, the number of branch banks in California increased by more than 70%.[19] The primary impetus for that increase was the merging of banks and their expansion into the suburbs. This led to the size of California's banks "tending toward the top range of U.S. banks." That meant access to greater and greater amounts of funds to those in the suburbs.[20]

The impact of branch banking was magnified by an act of Congress allowing banks to consider government contracts as collateral for loans.[21] This mattered to four of the Valley's five firms who had major "liquidity events" (acquisitions or IPOs) from 1952 to 1957: Eitel-McCullough, Hewlett-Packard, Litton Industries, and Varian Associates.

It was an advantage for Silicon Valley that it was located on a peninsula where the distance from the San Francisco on the north and San Jose on the south, was just shy of fifty miles. California's system of branch banking helped shrink the gap, emboldening firms to locate closer to Stanford University, and then to other firms, without distancing themselves from a quick and familiar source of loans. On the San Francisco Peninsula, branch banking helped speed up a shift of resources to the suburbs.

Cases in Resource Attraction and Deployment

Silicon Valley benefitted from growing up amidst the world's leading economy, near the West's premier financial center, and in a country growing the world's largest system of national defense. Yet proximity to resources alone does not guarantee their deployment to the benefit of a tech region. Abundance at the macro level does not always mean that individual organizations get the resources they need. What evidence exists regarding the impact of resource availability on organizations in Silicon Valley's early years? I will look at three organizations central to the pre-1960 development of what would later be known as Silicon Valley: the region's academic anchor (Stanford University) and the Valley's two largest indigenous firms during the 1950s (Hewlett-Packard and Varian Associates).

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[17] Marquis James and Bessie R. James, *Biography of a Bank* (New York, 1954), 46.
[18] E.A. Goldenweiser, *Branch Banking in California* (Washington, D.C., 1932), 1.
[19] Lynne P. Doti and Larry Schweikart, *Banking in the American West* (Norman, OK, 1991), 176.
[20] Doti and Schweikart, *Banking in the American West*, 177.
[21] Gerald D. Nash, *The American West Transformed* (Bloomington, IN, 1985), 34; Doti and Schweikart, *Banking in the American West*, 151.

Stanford University

The early decades of the 20th century represent the early growth of what Brian Balogh has dubbed the "prominstrative state," wherein much policy is set at the national level by experts, who in some cases have their own agendas. The judgement of those experts could direct resources to certain institutions, and in so doing help determine regional winners and losers. Balogh notes four types of institutions which could confer legitimacy to experts: research universities, voluntary coordinating agencies, professional societies, and foundations. All four would matter in the Silicon Valley story.

Stanford was one of fourteen research universities comprising the inaugural membership of the Association of American Universities in 1900. As a magnet for, and producer of experts (especially in engineering), Stanford University became the academic anchor of Silicon Valley. Stanford's "steeples of excellence" attracted resources to the Valley from industry, foundations, and the U.S. government. Stanford University already had world-renowned scholars and departments (including electrical engineering) by early in the twentieth century.[22]

One such expert was William Durand. As head of Stanford's mechanical engineering program beginning in 1904, Durand would exercise influence beyond academia, in a voluntary coordinating agency, a professional society, and a foundation—all to Stanford's benefit.

An old Navy man, Durand's expertise was in propeller design. His application was in ships—until World War I broke out. A 1915 Congressional bill, sponsored by the secretary of the Smithsonian, established the National Advisory Committee on Aeronautics (NACA) to stimulate interest in aeronautics.[23] Based on his expertise in propellers, Durand was invited to be a charter member.

At NACA's first meeting, in 1915, Durand insisted on the need for research on aircraft propellers. The committee agreed. Here is where Durand's expertise, his affiliation with Stanford, and his position at NACA came together. The upshot was that Stanford University was funded to perform the propeller research (receiving forty percent of NACA's original research budget—more than that of all other universities combined) and thus established an aeronautical engineering program.[24] Including annual renewals of the original contract, Stanford received $40,000 from NACA by 1926. Alex Roland notes that since Durand was a member of the committee allocating the funds, "contracts with him today would be called a clear conflict of interest."[25] Although the committee was mindful of keeping business members ("special interests") off the committee, having done so, they seemed to have no problem funding one of their own—providing he was the best man for the job.[26] The contract from NACA brought important seed funds for Stanford's aeronautical engineering program. It also brought Stanford important legitimacy in the eyes of another source of funds: foundations.

Roger Geiger has shown how, by the early 1920s, American foundations had shifted their policies regarding higher education. Instead of funding "a broad spectrum of American colleges and universities," they focused on a small subset: major research universities. As one member of that small fraternity, Stanford was an early major beneficiary.[27] In January 1926, mining scion

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[22] Roger L. Geiger, *To Advance Knowledge* (New York, 1986), v, 39, 276-277.
[23] W.F. Durand, *Adventures* (New York, 1953), 53-54.
[24] S.W. Leslie, *The Cold War and American Science* (New York, 1993), 103.
[25] Alex Roland, *Model Research*, 2 vols. (Washington, D.C., 1985), 1: 33.
[26] Roland, *Model Research* 1, 34.
[27] Geiger, *To Advance Knowledge*, 140-173.

Daniel Guggenheim established the Fund for the Promotion of Aeronautics. The goal was to support civilian aviation, and the means to that end was higher education. Durand was appointed as one of ten trustees, only two of whom were academics. The other, Nobel Prize winning physicist A. A. Michelson, represented the University of Chicago, which had no engineering school.[28] Durand took the same approach he did at NACA, unencumbered by concern regarding potential conflicts of interest.

Less than four months after the announcement of the Guggenheim Fund's creation, Stanford President Ray Lyman Wilbur submitted a proposal for a $330,000 grant. Highlighted in the proposal was the fact that Stanford already had eight members (including Durand) of the National Academy of Sciences. In addition, Wilbur noted Stanford's $28 million endowment, one of the largest in the country. Most important, though, was the 1916 "beginnings of a research center in aeronautics" at Stanford, made possible by funding from NACA—and twelve reports testifying to the fruits of that research.[29] In August, Stanford University issued a press release announcing receipt of a $300,000 grant from the Guggenheim Fund.[30] Stanford used the money to hire two faculty members, replace its laboratory, and add a 90 mile-per-hour wind tunnel.[31] Within less than a decade of the initial grant, Stanford was one of only three American universities fully accredited by the American Council on Education to grant doctorate degrees in aeronautical engineering.[32]

By the end of the 1930s, forty of Stanford's aeronautical engineering graduates went to Douglas Aircraft, Boeing, Lockheed, and elsewhere in industry. This mattered in two ways. By the mid-1950s, after the program had hit hard times, Stanford alumni in the industry raised $130,000 to save the program.[33] Stanford then had collaborations with the NACA Ames Research Center in Sunnyvale, and with Lockheed (which moved its missiles systems division to Sunnyvale in 1956 and became the region's largest employer by 1959). These efforts made Silicon Valley a major player in the aerospace industry, which had manifold electronics needs. The early expertise of William Durand played no small role in bringing resources to Stanford from NACA, from the Guggenheim Fund, and finally from existing companies in the aerospace industry.

Stanford's ability to attract funds from the deepest pockets of all, the federal government came late, primarily after World War II. A prolonged budget crisis in the 1930s and 1940s cut so deep that it provided an opportunity for Stanford's administrators to generate entrepreneurial responses—and they did.[34] During the war, Stanford received contracts worth $500,000, which paled compared to MIT ($117 million), Caltech ($83 million), and Columbia and Harvard ($30

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[28] Daniel Guggenheim letter, 18 January 1926, Daniel Guggenheim Fund Papers, Box 1, Library of Congress.

[29] Wilbur to Trustees, 13 May, 1926. Guggenheim Fund Papers, Box 15, folder "Stanford University Endowment 1926-1928."

[30] Press Release, 8 August 1926. Guggenheim Fund Papers, Box 15, folder "Stanford University Endowment 1926-1928."

[31] Leslie, *The Cold War and American Science*, 105.

[32] Leslie, *The Cold War and American Science*, 106.

[33] Leslie, *The Cold War and American Science*, 117.

[34] Stephen B. Adams, "Stanford and Silicon Valley: Lessons on Becoming a High-Tech Region," *California Management Review* 48, 1 (2005), 29-51.

million each).[35] After having been what Stuart Leslie terms a "benchwarmer" during the war, in 1946 the university had government contracts worth $127,000, which included Stanford's first contract with the Office of Naval Research (ONR).[36]

Frederick Terman, Stanford's newly appointed Dean of Engineering, had headed the Radio Research Laboratory at Harvard, and returned to Stanford with eleven members of his staff. They would become the core of Stanford's Electronics Research Lab (ERL). Terman's knowledge of, and contacts at, government agencies helped. By 1947, half of Stanford's engineering school budget came from the military.[37]

In the 1950s, Stanford took direct outreach measures that attracted resources from industry: the Stanford Industrial Park (rents from primarily high-tech firms), the Honors Cooperative Program (double tuition for graduate work by employees of local firms), and Affiliates Programs (annual stipends from firms wishing to hire Stanford high-tech graduates and seeking early access to Stanford-developed technology). Most of the money Stanford attracted was from established firms based outside of the Valley.[38]

Stanford's work with the government and industry proved both an end in itself and a means to another end: more foundation money. Thanks to the Stanford administration's proven ability to deploy resources and to maintain specific plans for how to spend a future windfall, the university moved to the top of the Ford Foundation's list of priorities. During the period 1950-1954, Stanford was one of only six universities to receive more than $1 million from the Ford Foundation; Harvard, at about $5.5 million, was the leader.[39] The result was a record $25 million matching grant in 1960, which helped propel the Valley's academic anchor to the ranks of a handful of elite universities.[40]

Resources to Start-Ups

Most of the successful pre-1960 tech firms in the Valley did substantial work for the federal government. There has been a tendency to conflate contracts (revenue/income statement) with financing (debt or equity/balance sheet). I will show the Valley's two largest tech firms in the 1950s (Hewlett-Packard and Varian Associates) gathered financing.

Hewlett-Packard

In 1937, Hewlett and Packard began to correspond in earnest about starting a company. Packard worked for General Electric in Schenectady and was willing to return to Palo Alto only when Frederick Terman landed funding for him in 1938. Hewlett-Packard's first product, an audio oscillator (which William Hewlett developed in a Stanford laboratory), was famously used by

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[35] Steve Blank, "The Endless Frontier," Part 1, 6 Dec. 2017, *Huff Post The Blog*, viewed 27 Sept. 2018, URL: https://www.huffingtonpost.com/steve-blank/science-and-industry_b_2471971.html

[36] Leslie, *The Cold War and American Science*, 45.

[37] Steve Blank, *The Secret History of Silicon Valley*, Part VII, 3 Aug. 2009, steveblank.com, viewed 27 Sept. 2018, URL: https://steveblank.com/2009/08/03/the-secret-history-of-silicon-valley-part-vii-we-fought-a-war-you-never-heard-of/

[38] Adams, "Stanford and Silicon Valley," 37-42.

[39] Joseph M. McDaniel, Jr. to H. Rowan Gaither, Jr., 27 April 1955. Ford Foundation Collection, RG 21, Series 6, Box 8, Folder 91, Ford Foundation Archives.

[40] C. Stewart Gillmor, *Fred Terman at Stanford: Building a Discipline, a University, and Silicon Valley* (Stanford, CA, 2004), 358.

Walt Disney Productions for the sound systems used in theaters for the movie *Fantasia*. Yet before becoming a primarily commercial enterprise, H-P relied heavily on government work. It was a 1940 subcontract from ITT, based on which the company expanded its staff, that taught Packard that the company needed financing. When payment from ITT lagged, Packard learned the difference between income and cash flow.[41] He initially relied on his parents: "Consequently, to handle this increase [in orders], we should really have more working capital," Packard wrote his father, "and so if your kind offer is still open, we would like to borrow $500 or whatever you can spare at the present time."[42] By early 1941, Packard's parents had provided the fledgling firm three increments of $500 loans at 4% interest.[43]

When Hewlett and Packard needed more money, they benefited from being in a suburb of San Francisco. Residents of towns on the periphery of California cities could form face-to-face relationships with bankers who, in turn, had access to a great deal of resources. Typically, the start-up would form a relationship with a local bank or branch, but would be close enough to the city that, when necessary, principals from the firm could stop in and meet with officials of the larger bank, who had authority to grant larger loans. This was precisely the situation for Hewlett-Packard by the time the company was seven years old. Their initial bank, the Palo Alto National Bank, provided the firm a loan of $500, which was fine for a small business, but ultimately insufficient for a start-up on the make. The company's financing requirement exceeded the capacity of the local bank.[44] A solution, in spring of 1945, was to also work with San Francisco's Wells Fargo Bank, thereby gaining access to manifold more resources. It was convenient to be within an hour of one of the largest banks in the West. In May, H-P received a loan of up to $300,000. Thanks to action by the U.S. Congress in 1941, firms doing defense work could use their contracts as collateral—and H-P did.[45]

From 1939 to 1957, H-P's annual sales grew from just over $5,000 to nearly $30 million.[46] Such growth was accompanied by real estate and capital expenditures. The company needed a $90,000 real estate loan from Wells Fargo in the late 1940s as part of a new building program.[47] In 1951, the company needed an additional $150,000 loan from Wells Fargo for plant and equipment.[48]

Branch banking also helped H-P. In 1945, the Anglo-California National Bank acquired the Palo Alto National Bank, thereby giving H-P access to resources of a bank fifty times larger. As the company's working capital needs increased, loans from Anglo-California also increased. The

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[41] David Packard, *The H-P Way: How Bill Hewlett and I Built Our Company* (New York, 1995), 50-51.

[42] David Packard to Sperry Packard, 7 March 1940, David Packard Papers, 1939-1953, Series 1, Box 1, Folder 2. Keysight Corporate Archives.

[43] D. Packard to S. Packard, 7 March 1940; S. Packard to D. Packard, 10 July 1940; D. Packard to S. Packard, 16 July 1940; S. Packard to D. Packard, 15 Feb. 1941, Packard Papers, Series 1, Box 1, Folder 2.

[44] Packard, *The H-P Way*, 52.

[45] "Provisions for Hewlett-Packard Co. 'T' Loan," 30 March 1945, Packard Papers, Series 2, Box 2, Folder 39.

[46] Packard, *The H-P Way*, 46, 77.

[47] "Report on Progress of Hewlett-Packard Company," February 1948, Packard Papers, Series 2, Box 2, Folder 10.

[48] "Report on Operations and Estimate of Capital Requirements for 1951,"July 1951, Packard Papers, Series 2, Box 2, Folder 10.

relationship with Anglo-California helped in the early 1950s, as H-P's loan needs rose by $500,000 in 1951 and $800,000 in 1952.[49] Both commercial and defense needs grew well beyond the means of the Palo Alto National Bank before its acquisition by the Anglo California National Bank. While Hewlett-Packard's story is unique, the point with most Silicon Valley start-ups is similar. Even for defense contractors, the California banking system was a crucial part of the ecosystem that helped stimulate entrepreneurship.

The Klystron Group

In the 1940s and 1950s, several American technology firms established satellite operations in the Valley. Some wanted access to the expertise (professors and students) at Stanford; some wanted to be part of growing industry clusters. In other cases, though, the primary role for the established firm was to provide resources to innovators based in the Valley. That was the case with Beckman Instruments (based in Southern California) launching Shockley Semiconductor in 1955. In that respect, the Valley was a beneficiary of America's postwar industrial might. A group working on the klystron tube at Stanford University in the late 1930s had a different story

Before the formation of Varian Associates in 1948, the company-to-be was incubated in two difference places by two different organizations in the 1930s and 1940s: Stanford University and the Sperry Gyroscope Company. Two of the company's cofounders, Russell Varian and William Hansen, met at Stanford, and roomed together in the 1928-1929 academic year. Both began doctoral studies at Stanford; Hansen earned a Ph.D. and Varian stopped after a Masters. After completing his undergraduate degree, Varian worked for television inventor Philo Farnsworth in San Francisco. Farnsworth's San Francisco-based patent attorney, Donald Lippincott, would help Varian and Hansen during their incubation years.

In 1934, Hansen (who was now an assistant professor in Stanford's physics department), was working in the field of x-rays, and consulted periodically with Varian. After many visits to Stanford during the early months of 1937, Russell Varian and his brother Sigurd moved there in May to work on a microwave project. An agreement with the university provided the brothers with facilities (some shop space and some laboratory space), $100 for raw materials, and half of all royalties from any resulting revenues, but no salary.[50] This was an early example of the ubiquitous "soft money" (we provide space if you bring funding) at Stanford University.

Things moved quickly from there. In June, Russell Varian conceived the klystron, a form of vacuum tube that would be useful for radar transmitters, and by August had a working model. During the coming months Lippincott's firm worked on patent issues, and the Varians ran through most of their savings. Searching for a motivated lead customer for the klystron, Sigurd headed to San Francisco to meet representatives of his old employer, Pan American Airways, as well as the Phillips Corporation, the War Department, the Navy, and the Bureau of Air Commerce (BAC).[51] Two BAC officials expressed keen interest. That level of interest was not sustained at the BAC's higher levels, but Hugh Willis, the Sperry Gyroscope Company's newly

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[49] "Cash Forecast 1952," Packard Papers, Series 2, Box 2, Folder 10.

[50] "Statement of William W. Hansen," 24 May 1945, 30. Papers of the Sperry Gyroscope Company, ACC 1915, Box 68, Hagley Museum Archives.

[51] William Hansen to J. Hugh Jackson, 17 Nov. 1937, William Hansen Papers, SC 126, Box 1, Folder 6, Stanford University Archives; Russell Varian, "Some Examples of the Relation Between Basic Research and Useful Devices," 8 May 1958, Varian Associates Papers, 73/65c, Box 3, Folder 44, Bancroft Library.

appointed chief research engineer, visited the local CAA and showed interest in the klystron. Willis was in touch with William Hansen by the end of November, leading to a three-way contract signed in 1938 between Sperry, Stanford, and the Varians.[52]

Stanford University provided the laboratory and shop space, and some equipment. Sperry Gyroscope provided the salaries ($2,500 per year for each Varian), and received exclusive manufacturing rights. The Varian brothers and Professor Hansen also received royalties.[53] Stanford received $25,000 in 1938 and increasing amounts thereafter.[54]

In late 1940, Sperry moved the project to its Garden City, Long Island, plant where the core group remained until after World War II ended.[55] At Stanford and then in Garden City, the core group—including the Varians and William Hansen—grew to include Stanford engineering graduates Myrl Stearns and Ed Ginzton, among others. The group had a chance to work together as a team before ever taking the risk of starting a company.

By the beginning of 1946, it was clear that Sperry's days hosting the klystron research and development group were numbered. Of the Klystron staff from only a year earlier, ten out of eleven researchers had either left or planned to leave.[56] The klystron group's incubation days (first by Stanford, then by Stanford and Sperry, and then by Sperry) had ended, the team returned to California, founded Varian Associates in March 1948, and tapped different sources of funding.

Varian Associates

Varian Associates opened for business in San Carlos with an investment of $22,000 from the founders and their friends.[57] Resources were a challenge for the company from the beginning. The founders pronounced a philosophy of expanding "as rapidly as possible to attain a size capable of handling important work on a sound basis." From March 1948 to July 1949, the company grew from a half dozen people to three dozen; at the same time, its space needs quintupled. The Executive Committee voiced concerns about gathering necessary resources to sustain the growth, and "now felt that expansion should intentionally be stopped, at least temporarily, to gain capital."[58]

The moratorium on growth would not last—especially with the outbreak of the Korean War. A decade before the establishment of the Valley's first venture capital firm, company officials considered a number of funding options. In February 1950, president Myrl Stearns, armed with advice from the company's banker, the vice president and general manager of the Palo Alto branch of the Anglo California Bank, presented four possible sources to the board of directors:[59]

1. "Private banking," specifically from the Anglo California Bank.
2. "Other private sources."

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[52] Hugh Willis to Hansen, 29 Nov. 1937, Hansen Papers, Box 1, Folder 6.
[53] David L. Webster to Ray Lyman Wilbur, 24 Feb. 1938, Hansen Papers, Box 1, Folder 7.
[54] "History of Klystron Project Funds Taken from Pink Sheets of V. Voorhees," 1 July 1940, Hansen Papers, Box 2, Folder 16.
[55] D.L. Webster to R.L. Wilbur, 28 Nov. 1940, Hansen Papers, Box 2, Folder 18.
[56] E. Ginzton to W.T. Cooke, 21 Jan. 1946, Stanford Engineering School Papers, SC 165, Series I, Box 8, Folder 14, Stanford University Archives.
[57] Gillmor, *Fred Terman at Stanford*, 277.
[58] "Special Meeting, Executive Committee," 22 July 1949, Varian Associates Papers, 73/65c, Carton 1, Folder 1, Bancroft Library.
[59] "Executive Committee Meeting," 27 April 1949, 73/65c. Carton 1, Folder 1.

3. "American Research and Development Corporation," of Boston, one of America's first venture capital firms.
4. The Reconstruction Finance Corporation.

By the end of the fiscal year ending September 1950, Varian Associates had annual sales just shy of $500,000, and employed just over 100 people. The company's financing was primarily through bank loans of about $120,000 from the Palo Alto branch of the Anglo California Bank.[60] That changed in a hurry. Less than one year later, the company would need working capital of about $2.7 million and would need to expand its production facilities.

In September 1951, Varian resolved several of these interrelated issues. The company agreed to a 99-year lease in Stanford Industrial Park. The building they planned to construct would act as collateral for a $1.52 million Reconstruction Finance Corporation loan. Meanwhile, the company's bank loans (secured by receivables and government contracts) with Anglo California had increased to more than $500,000, and the company's revolving credit agreement, guaranteed by the U.S. Air Force, grew to $600,000 by October. In short, the company had financing of more than $2.5 million guaranteed or collaterized by the U.S. government. It's a good thing they did: by the following April, executives expected sales to rise to $640,000 *a month*, with associated working capital needs of $2.7 million.[61] Having the relationship with Anglo American Bank still mattered, however: when the RFC ceased operations in 1954, the bank took over Varian's RFC loan.[62]

In November 1955, Dean Witter (a San Francisco-based securities firm) guided Varian through a sale of convertible debentures and then, the following year, through a common stock offering.[63] A year later, Hewlett-Packard joined Varian Associates as public companies. Clearly, there was money to be made in the Valley. In 1959, the venture capital industry set up shop there with the founding of Draper, Gaither, and Anderson.

Conclusion

One hundred years after California's first Gold Rush, Carey McWilliams wrote, "Historians have a fine time in California speculating about the course events might have taken had gold not been discovered." He posed a hypothetical question: What if the discovery had instead been made elsewhere?[64]

A parallel question looms over California's second Gold Rush, in Silicon Valley. What if William Shockley had set up shop somewhere besides Silicon Valley? The assessment I have just made of the resources available, and the institutions and laws in place relevant to the deployment of these resources help us toward an answer. First, its location in the world's wealthiest nation, at a time when its military and related technological capabilities were catching up to its economic power, made a huge difference. Whether it was access to defense contracts—and accompanying benefits and protection—the resources of established firms or of resources repurposed from earlier industrial activities, the U.S. was an ideal place to be. Furthermore, California and San Francisco had their own advantages: a financial center blessed with a green light to disperse resources, via banks, to suburbs as needed.

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[60] "Special Meeting," 6 Nov. 1950, 73/65c, Carton 1, Folder 1.
[61] "Executive Committee Meeting," 1 April 1952, 73/65c, Box 1, Folder 3.
[62] "Statement of Financial Condition for 12/31/54," 73/65c, Carton 2, Folder 32.
[63] "Letter to Stockholders," 21 Sept. 1956, 73/65c, Box 1, Folder 10.
[64] McWilliams, *California: The Great Exception*, 36.

Finally, looking back to the 1909-1959 period begs the question regarding similarities or differences between the periods of Silicon Valley history. At face value, Silicon Valley's two worlds (pre-1960 and post-1960) look quite different. The pre-1960 world was dominated by government contracts and urban resources. The post-1960 world was dominated by commercial work and venture capital, in a suburban setting.

On the other hand, there are striking similarities. Today's Silicon Valley involves far from a normal distribution of success. Instead, the lion's share of the rewards goes the very few. The macro impact is also far from normally distributed. The United States is responsible for a huge share of the world's venture capital. Such maldistribution of resources was also true of the pre-1960 Valley, whether in terms of recipients of government contracts, numbers of universities in the game, or strategies of foundations (focusing on "impact, which suggests funding the few rather than the many).

The early Silicon Valley connects to today's Silicon Valley via a sense of "small worlds" and an ideology of expertise and meritocracy that rationalizes the rewards going to the few: few individuals, few organizations, and few regions. In that respect, Silicon Valley's past is not so distant.