

Regionalism in Stanford's Contribution to the Rise of Silicon Valley

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In this article I explore the powerful sense of regional solidarity that accompanied the rise of Silicon Valley. From the early years of Stanford University, the university's leaders saw its mission as service to the West and shaped the school accordingly. At the same time, the perceived exploitation of the West at the hands of eastern interests fueled booster-like attempts to build self-sufficient indigenous local industry. Thus, regionalism helped align Stanford's interests with those of the area's high-tech firms for the first fifty years of Silicon Valley's development. The distinctive regional ethos of the West during the first half of the twentieth century is an ingredient of Silicon Valley's already prepared environment, an ingredient that would-be replicators ignore at their peril.

In his introduction to *Understanding Silicon Valley*, Martin Kenney notes, "Frederick Terman, credited by many as the founder of Silicon Valley, can better be understood as a catalyst and a booster in an already prepared environment."¹ What was the nature of that prepared environment? Recent scholarship suggests that well before 1925, when Terman joined the faculty of the Stanford engineering school, the environment included two ingredients: an active local high-tech industry and the early involvement of Stanford University

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1. Martin Kenney, "Introduction," in *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*, ed. Martin Kenney (Stanford, Calif., 2000), 4.

in that industry.² I explore a third ingredient, one thus far excluded from analyses of the already prepared environment: a powerful sense of regional solidarity that accompanied the rise of Silicon Valley. I will show that what Terman later referred to as “a spirit of cooperation, almost a booster spirit,” in the Valley was actually the outgrowth of a pervasive western regionalism in the first half of the twentieth century.³

Why has this element in the rise of Silicon Valley been ignored? Journalistic accounts of the Valley began to proliferate in the early 1970s.⁴ By then, although several elements of the rise of Silicon Valley were still present and visible (including Terman), western regionalism had largely disappeared. Moreover, Silicon Valley’s reputation and its association with the knowledge economy surrounded the region with an aura of something new and sophisticated. Whereas industrial location in the old economy relied on proximity to raw materials, transportation nodes, or blue-collar labor, the new economy was based on proximity to university anchors. Was it not the old economy that featured regional boosterism and trade associations? Was it not the old economy that cared about what was going on in Washington? Was it not the old economy that had the fingerprints of Herbert Hoover all over it? Yet the development of Silicon Valley had relied on all of these features, and what tied them together was a powerful sense of regional identification and shared grievance during the Valley’s formative years.

A sense of solidarity permeated the eleven western states in the first half of the twentieth century. Westerners complained about having a “colonial” relationship with the East; their raw material base—with corresponding jobs, profits, and economic growth—was “plun-

2. Timothy J. Sturgeon, “How Silicon Valley Came to Be,” in *Understanding Silicon Valley*, ed. Kenney, 15–47; AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128* (Cambridge, Mass., 1994); Stuart W. Leslie, “How the West Was Won: The Military and the Making of Silicon Valley,” in *Technological Competitiveness: Contemporary and Historical Perspectives on the Electrical, Electronics, and Computer Industries*, ed. William Aspray (New York, 1993), 75–89; Hugh G. J. Aitken, *The Continuous Wave: Technology and American Radio, 1900–1932* (Princeton, N.J., 1985).

3. Frederick Terman, “Bay Area Electronics—Then and Now,” speech delivered at Western Electronics Manufacturers Association (the successor to WCEMA) thirtieth anniversary dinner, 20 Nov. 1973, pp. 9–10. Stanford University Archives, Special Collections [hereafter, SC] 160, series VIII, box 4, folder 5.

4. Don C. Hoefler, “Silicon Valley, USA,” *Electronic News* (11 Jan. 1971); Gene Bylinsky, “California’s Great Breeding Ground for Industry,” *Fortune* (June 1974), 128–35, 216, 218, 220, 224; Dirk Hansen, *The New Alchemists: Silicon Valley and the Microelectronics Revolution* (Boston, 1982); Everett Rogers and Judith Larsen, *Silicon Valley Fever* (New York, 1984); Michael Malone, *The Big Score: The Billion Dollar Story of Silicon Valley* (New York, 1985).

dered" by distant forces. The region's perceived exploitation at the hands of eastern interests fueled booster-like attempts to build indigenous and self-sufficient local industry.

At the same time, Terman voiced a parallel complaint about the raw material base of a knowledge economy: the local area suffered from a brain drain of Stanford-trained engineers to eastern industry. Terman, too, sought to establish indigenous industry: high-tech companies near Stanford University. Terman found receptive ears because regional loyalty imbued key individuals who shaped Stanford University and established the early Silicon Valley firms. Regionalism was a catalyst, providing the principal players with energy that sped up the Valley's development. It also aligned the interests of Stanford and those of the area's high-tech firms at the time of Silicon Valley's takeoff.

In this article, I will show how leaders of Stanford University from its early years saw its mission as service to the West and shaped the university accordingly. I will explore the rise and fall of the Federal Telegraph Company and show how the local high-tech industry developed mistrust and resentment of larger eastern firms. I will discuss the broader environment of regional solidarity that peaked during World War II, including the actions of local high-tech business. I will show how a regional spirit imbued the activities of Terman and Stanford after World War II, the takeoff period for Silicon Valley, and I will conclude by suggesting some implications for those wishing to replicate the Silicon Valley model.

A Regional University

In the second half of the twentieth century, Stanford University rose from a regional school to join the ranks of the world's elite universities. Today, "regional university" tends to be pejorative, referring to a school that has failed to gain a national reputation. Yet "regional university" has another meaning, referring to a school that has made a conscious effort to meet the needs of nearby communities. Such was the case with Stanford, which set out to prepare its undergraduates for the real world (in contrast to the "ivory tower" approach of older denominational schools) and sought to serve the needs of the Pacific Coast.⁵ As Robert Kargon and Stuart Leslie put it, "Stanford

5. Rebecca S. Lowen, *Creating the Cold War University: The Transformation of Stanford* (Berkeley, Calif., 1997), 19.

never entirely forgot its founder's aspiration for an institution which would contribute to the development of the Western region."⁶

Such was the mission envisioned for the school by its founder, Leland Stanford, a western railroad magnate and political leader in California. When the university opened in 1891, "a university education meant a classical education," wrote Ray Lyman Wilbur (president from 1916 to 1941), "and what was 'practical' had little or no academic standing. Naturally, people were confused to see a new university start up in California that reversed that order."⁷ Indeed, in his 1891 inaugural convocation address, Leland Stanford reminded the school's student body that "life is, above all, practical; that you are here to fit yourselves for a useful career."⁸

In the audience was Herbert Hoover, who during the next seventy years would promote Leland Stanford's vision for the university and personify its possibilities. A graduate of the university's inaugural class of 1895, Hoover embarked on a successful career in mining engineering before World War I and then became a world-famous humanitarian during and after the war. In the 1920s, Hoover went to Washington as the secretary of commerce and then became president of the United States. Throughout, Hoover maintained Stanford as his home base, and in 1912 he began nearly fifty years of service on the university's board of directors.⁹

During his tenure on the board, Hoover played a larger role than any other individual in determining who would lead the university and how. He had a hand in the selection of four successors to Stanford's first president, David Starr Jordan. After orchestrating the selection of his mentor, the geologist John Branner, as the university's second president in 1913, Hoover must have been pleased with the beginning of Branner's inaugural address: "Being a practical man, the problems of life appear to me to be simply the problems of each day as the days bring them along."¹⁰

Given the important role Hoover would play as trustee, his attitudes regarding the university and the region loom large. An example was his approach to the replacement of Branner in 1914: rather than a classically trained academician from the East, Hoover sought

6. Robert Kargon and Stuart Leslie, "Imagined Geographies: Princeton, Stanford and the Boundaries of Useful Knowledge in Postwar America," *Minerva* 32 (Summer 1994): 132.

7. Ray Lyman Wilbur, *The Memoirs of Ray Lyman Wilbur 1875-1949*, ed. Edgar Eugene Robinson and Paul Carroll Edwards (Stanford, Calif., 1960), 279.

8. George H. Nash, *Herbert Hoover and Stanford University* (Stanford, Calif., 1988), 6.

9. *Ibid.*, 12-14, 32.

10. Wilbur, *Memoirs*, 177.

a practical man from the West. In October Hoover wrote to the chairman of the board of trustees that Stanford was “essentially a Western institution, with ideals entirely different from those which obtain on the Atlantic seaboard.” The next president should be “a Western man,” he argued: “The old-line President who was able to preside at Sunday School Conventions and make choicely classical orations on public occasions is not the type of man Stanford needs. . . . Nothing would be more disastrous than to choose some classical Professor from the East.”¹¹

In the spring of 1915, President Branner and trustee W. Mayo Newhall returned from the East recommending that Princeton classics professor Edwin Capps be named Stanford's next president. Hoover responded predictably, suggesting that such a “social fop” and “sycophant to [the] Wall Street bunch” represented the “absolute negation of [the] type required for president.” Hoover even considered taking the job himself rather than seeing “some loudmouthed Princetown professor put in the position”; he (Hoover) “would be willing to take three years out of [his] life and throw them away.”¹² Hoover did not need to make that sacrifice, however, because his friend Ray Lyman Wilbur took the job. Dean of Stanford's School of Medicine, Wilbur shared Hoover's educational priorities, noting with satisfaction toward the end of his life that he had “seen education move from dead languages to laboratories.”¹³

With Hoover's encouragement, Wilbur would modernize the institution, establishing separate schools to house the various departments. Several of the new schools reflected the practical emphasis that Leland Stanford envisioned and that Herbert Hoover embodied. By the mid-1920s, Stanford had separate schools of law, medicine, and engineering (of which Hoover's brother, Theodore, served as dean).¹⁴ During the mid-1920s, Hoover squeezed time out of his schedule in Washington to champion the establishment of a graduate school of business at Stanford.

The establishment of the business school reflected the regional sensitivities of Stanford University. The business school's mission, as envisioned by Hoover, was manifold. The school would serve the state: “California is a business empire in itself. Its problems differ from all other parts of the country; it needs men trained for entry into the business world in its own setting.” Toward that end, Hoover saw the establishment of the school as a way to stem the loss to the

11. Nash, *Herbert Hoover and Stanford University*, 50.

12. *Ibid.*, 52–53.

13. Wilbur, *Memoirs*, xi.

14. *Ibid.*, 394.

East of a key resource: “Several hundred California youths are in attendance at eastern universities. The demand for these men in the East upon graduation is far in excess of the supply, and California is losing many good brains.” The school would also serve the region by “research[ing] problems of business trends, of markets and distribution of the Pacific Coast, for the benefit of the commercial community and in cooperation with it.” Finally, the West had an unfilled need for a graduate business school: “There is no such department in any university west of Chicago.”¹⁵

In the spring of 1927, Professor Eliot Mears of the business school took seven weeks to visit twenty-two western universities to “establish contacts” for the new school, and he reported receiving high levels of cooperation. Mears wrote: “Stanford University occupies an unusually strategic position in the Far West, because of its geographic situation, because it is a private institution, and because of its standards. Without question, the eleven western states are a more or less homogenous unit, with common problems and sentiments, looking to the Pacific Coast—primarily California—for leadership.” Therefore, “Stanford’s leadership in the problems of the eleven western states and of the Orient gives her a distinctive position.”¹⁶

With Hoover, the engineer, as a principal trustee along with several businessmen, the composition and inclinations of Stanford’s board must have been an attraction when Frederick Terman joined the faculty of Stanford’s engineering school in 1925. As a professor of electrical engineering, as the dean of the School of Engineering, and then as the provost at Stanford University, Terman would help build Stanford’s electrical engineering department and School of Engineering into world-class institutions that either competed with or surpassed the engineering schools at the Massachusetts Institute of Technology (MIT), the University of California, Berkeley, and the California Institute of Technology. Terman would help attract the necessary brains to the area and would help make Stanford into the prototypical university anchor to catalyze the development of a high-tech region.

The son of a prominent Stanford psychology professor, Terman grew up in Palo Alto, California, and graduated from Stanford in 1920. He moved east to do his graduate work, earning a Ph.D. in

15. J. Pearce Mitchell, *Stanford University, 1916–1941* (Stanford, Calif., 1958), 79; Herbert Hoover to Wallace Alexander, 15 Aug. 1924, Herbert C. Hoover Papers, Hoover Institution, box 343, “Stanford University School of Business.”

16. Professor Eliot Mears to Dean W. E. Hotchkiss, 16 April 1927. Stanford University Archives, SC 165, series I, box 7, folder 24.

electrical engineering at MIT in 1925. His mentor at MIT, Vannevar Bush, steered his students toward practical projects. Bush practiced what he preached, helping found the radio tube company Raytheon Corporation in 1922, while Terman was his student. Terman would encourage his students to tackle problems with immediate applications to industry. Terman's book *Radio Engineering* also had a practical bent and became a bestseller.¹⁷ Imbued with principles of university-industry cooperation, in many ways Terman found an already prepared environment at Stanford University. Another attraction must have been the local high-tech business community, anchored by the Federal Telegraph Company (FTC).

The Predicament of Local High-Tech Industry

Before 1925 high-tech industry near Stanford revolved around FTC, a Palo Alto maker of radio tubes. FTC's relationship with Stanford University foreshadowed the sort of relationships Terman would later foster between Stanford and local entrepreneurs. Cyril Elwell, a recent Stanford graduate, founded the firm in 1909 at the urging of the electrical engineering department chair, Harris J. Ryan, and with the financial support of Stanford's president, David Starr Jordan. The new firm's directors included C. D. Marx, chair of Stanford's civil engineering department, and Stanford law school graduates R. W. Barrett and F. A. Wise.¹⁸ Decades before "family trees" appeared on Silicon Valley office walls, tracing the roots of the region's various semiconductor firms to Fairchild Semiconductor Corporation, FTC alumni had launched firms such as Magnavox, Fisher Research Laboratories, and Litton Industries.¹⁹

Despite FTC's superb technical innovation and its garnering of substantial Navy contracts during World War I, the company never prospered. Strapped for cash early on, the firm fell into the hands of absentee financiers, relegating the Stanford group to a secondary role. Clarence Mackay acquired the floundering firm in 1928, moved it to Newark in 1930, and merged it into International Telephone and Telegraph.²⁰ "Properly managed," Terman mused later, "this com-

17. Stuart W. Leslie, "The Biggest Angel of Them All: The Military and the Making of Silicon Valley," in *Understanding Silicon Valley*, ed. Kenney, 52.

18. Aitken, *The Continuous Wave*, 122–23.

19. Saxenian, *Regional Advantage*, 31; Sturgeon, "How Silicon Valley Came to Be," 30.

20. Aitken, *Continuous Wave*, 130, 134.

pany would logically occupy the place of the Radio Corporation of America [RCA].”²¹ The federal government was also complicit in FTC’s fall, however, having sanctioned an arrangement that granted RCA control over key transmission, amplification, and reception patents.²²

It was under the ever-present threat of RCA litigation that the West Coast electrical industry came of age. Some of the western firms battled RCA in court (some of them even won), while others sought niches too small to interest the eastern behemoth. In this environment, a model of regional industry cooperation developed. Pacific Coast radio engineers could cooperate on opposition to the eastern electronics establishment, symbolized by RCA. Terman contrasted the cooperative attitude of the West Coast electronics industry with the competitive attitude of the eastern firms: “I think it was ‘every man for himself’ much more back [east]. . . . [East Coast] manufacturers would never cooperate [on standards for vacuum tubes], partly because of the patent situation.”²³

The cooperative attitude of West Coast firms was largely compensatory, an indication of how small, weak, and embattled the companies were. After the departure of FTC in 1930, high-tech industry on the Peninsula south of San Francisco featured some FTC spin-offs, but they were small companies. This became a problem for Terman. Unable to find work locally, several of Terman’s students had gone east to work at Bell Labs or General Electric.²⁴ It was difficult to establish a critical mass of brainpower in the area in the face of such a loss of talent.

On the eve of World War II, both the brain drain from the loss of his students and the departure of FTC reinforced the same lessons for Terman: the importance of developing indigenous industry in the area and the role that Stanford must play in making that happen. Terman did not need to go far to identify the major obstacle in meeting his goal: the absence of major technical firms in the area. Echoing Hoover’s concerns, Terman’s top priority became attracting top technical minds to Stanford and the surrounding area and keeping them there. Much of Terman’s subsequent efforts toward stemming this brain drain involved promoting high-tech industry near Stanford. Terman’s desire to develop indigenous industry and the regional sol-

21. “I.R.E. ‘Old Timers’ Talk” (14 June 1951), 5, in Stanford University Archives, SC 160, series VIII, box 1, folder 7.

22. Sturgeon, “How Silicon Valley Came to Be,” 27.

23. *Ibid.*, 28.

24. Terman Oral History Interview, pp. 28–29, Stanford University Archives.

identity of the local high-tech community dovetailed with a broader regional movement that had been years in the making.

A Regional Drive for Indigenous Industry

For the first four decades of the twentieth century, a major unifying theme in the eleven states west of the Rockies was a shared economic predicament. The predominant industries in the West had been extractive, from agriculture to mining, to oil, to lumber. Westerners shipped their bounty of natural resources east for processing and then imported finished goods. As of 1940, the West and South together contributed 65 percent of America's mineral production but only 20 percent of its manufacture (compared to 65 percent for the East).²⁵ Therefore, in several industries reliant on western resources, most of the jobs—and most of the profits—accrued in the East.

The West's economic predicament strengthened regional ties and catalyzed regional disaffection with the nexus of economic power. Westerners complained of having a "colonial" relationship with the East. Wyoming senator Joseph O'Mahoney (D) chaired the United States Temporary National Economic Committee, which focused on exposing the "unfair" concentration of economic power in eastern hands. At the same time, assistant attorney general Thurman Arnold, onetime mayor of Laramie, Wyoming, conducted an antitrust crusade. Arnold argued, "The mother country does not like to see competing industries develop in the colonies which would interfere with the dividends and the financial structure of the East."²⁶ The journalist Bernard De Voto referred to the West as a "plundered province."²⁷

During the war and in the immediate postwar years, most of the calls for regional economic development of the West emphasized freeing the region from its colonial relationship with the East. A. G. Mezerick's *The Revolt of the South and West* decried how World War II had been "the instrument with which the corporate clique in the East strengthened its grip on the economic life of the South and West" and presented an alternative in which "the goal is industrial self-determination." Wendell Berge, successor to Thurman Arnold as

25. Gerald D. Nash, *World War II and the West: Reshaping the Economy* (Lincoln, Neb., 1990), 187.

26. *Ibid.*, 181, 185.

27. Bernard De Voto, "The West: A Plundered Province," *Harper's* (Aug. 1934), 355–64. This was one of several pieces De Voto did for *Harper's* on the subject, including "The Anxious West" (Dec. 1946), 481–91, and "The West against Itself" (Jan. 1947), 1–13.

assistant attorney general of the United States, portrayed the stakes as even higher in *Economic Freedom for the West*: “The West is once more the frontier on which the question of American economic expansion will be decided.”²⁸

The period of mobilization before Pearl Harbor brought rising expectations to western hopes for economic parity with the East, but government agencies led by representatives of big business presided over a process that appeared to favor eastern firms. As a result, World War II brought an even greater concentration of economic activity in America. In 1941 the one hundred largest American corporations, located mainly in the East, had been responsible for 30 percent of the goods produced in the United States, but by 1943 the proportion had increased to 70 percent.²⁹

Increased economic concentration in the East brought a predictable political response from the West. In December 1941, Montana senator James Murray (D), chair of the Small Business Committee, convened hearings on the share of war contracts going to big business. Two-thirds of the wartime testimony heard by the committee and subsequently published dealt with issues in the West. Contracting frustrations also precipitated much state and local activity. In 1943 and 1944, representatives of western states met in San Francisco, Carson City, and Salt Lake City to map an economic path for the West. There was much discussion of the West’s “colonial” position, of the East’s “industrial monarchs,” and of the need for “cooperation” among the eleven states. Meanwhile, bodies such as the California Commission on Interstate Cooperation, the [Nevada] Governor’s Committee on Post-War Industrial Development, and Builders of the West pursued similar issues.³⁰

Much of the concern in the West surrounded steel and other industries that could use the region’s natural resources. The electrical industry also experienced an increase of eastern domination during the war as RCA, General Electric, Westinghouse, and Western Electric obtained substantial defense contracts. This concentration of contracting among electrical firms produced a reaction in the West. Frustrated by their inability to obtain what they considered their fair share of defense contracts, twenty-five California firms (about a dozen from northern California, organized by David Packard, and about a dozen from southern California, organized by Les Hoffman of Mission Bell Radio) banded together to make their case in Washington.³¹

28. Quoted in Nash, *World War II and the West*, 213–15.

29. *Ibid.*, 8.

30. *Ibid.*, 12, 13, 191–92, 205.

31. David Packard, *The H-P Way* (New York, 1995), 61.

The new organization, the West Coast Electronics Manufacturers Association (WCEMA), institutionalized a set of attitudes that was already widely shared on the West Coast. As Terman put it, “[WCEMA] worked hard to create a community spirit such that individual companies, even companies that were competitors in the marketplace, would work together for the good of the area.”³²

We have come to expect certain characteristics of trade associations: the setting of industry standards, the dissemination of “best practices,” salary surveys, attempts to improve the industry business climate through the shaping of regulations or distributing of government contracts, and efforts to limit excessive (“cutthroat”) competition. As AnnaLee Saxenian points out, WCEMA focused on “assisting the management of emerging firms, rather than on lobbying on behalf of established corporations.”³³ This is because WCEMA was not just an industry association but also a regional industry association.

The goal stated in the association’s charter was for individual firms to cooperate “to gain *their own* progress through the advancement of *the entire area’s* progress.”³⁴ Therefore, as past WCEMA presidents H. Myrl Stearns and Norman Moore suggest, the primary mission of the organization was to help western manufacturers compete with those in the East.³⁵ How did the Valley companies balance their desire to cooperate with their instinct to compete? As Stearns put it, “We took care of the East first, and then competed with each other.”³⁶

A Clarion Call

At Stanford University in the 1940s, the father of Silicon Valley also used the language of regionalism. When Terman became the dean of Stanford’s School of Engineering in 1946, he brought both good and bad news for the western region. During World War II, Terman had directed the Radio Research Laboratory on radar-related work and had had the opportunity to observe how other universities dealt with the federal government. While some schools garnered tens of millions in government research money (MIT had received more than

32. Frederick Terman, “Stanford Engineering and Local Industry,” speech presented to Chinese visitors, 17 July 1975, p. 5. Stanford University Archives, SC 160, series VIII, box 4, folder 7.

33. AnnaLee Saxenian, “Contrasting Patterns of Business Organization in Silicon Valley,” *Environment and Planning D: Society and Space* 10 (1992): 382.

34. WCEMA *Directory* (Los Angeles, 1955), 4. Emphasis in original.

35. H. Myrl Stearns and Norman Moore, interview with author, 15 June 2002.

36. H. Myrl Stearns, interview with author, 12 June 2002.

\$100 million), Stanford had been what Stuart Leslie called a “bench-warmer,” gathering thousands instead of millions.³⁷ World War II convinced Terman that involvement with the government might represent a significant opportunity for Stanford as well.

World War II represented a watershed for American research universities. Before the war, many universities were content with maintaining their distance from wider societal concerns. At such places, research agendas were set within the ivory tower by academicians. During the war, several universities made attempts to help with the war effort and undertook research projects for the government. Such sponsored research accelerated during the Cold War. Connections between universities and both national and local concerns became quite common, and the universities identified themselves more as “public-service institutions.” By the time students protested in the 1960s and 1970s, the universities had become, in many respects, instruments of public policy.

At Stanford, Fred Terman’s blueprint for helping local electronics firms was one manifestation of a sea change that occurred at Stanford in the 1940s. The principal change involved attitudes toward the federal government and a new willingness to pursue government funding and contracts. Influenced by trustee Herbert Hoover’s contempt for the administration of Franklin Roosevelt, during the 1930s Stanford’s president, Ray Lyman Wilbur, opposed deepening the university’s involvement with the federal government. Even when Stanford, like several other private universities, experienced severe financial woes, Wilbur balked at accepting money from the Roosevelt administration, fearing that the university might lose its autonomy.³⁸

Wilbur’s retirement in 1943, combined with the exigencies of war, changed everything for Stanford. Donald Tressider, who succeeded Wilbur, championed the idea of the university as an institution serving public needs, from national security to regional economic growth. Toward that end, he restructured the university, creating institutes that would receive money from business. He also encouraged faculty to meet the needs of regional industries, including electronics. Tressider sought the counsel of Terman, among others, and helped position the university to anchor a high-tech region.³⁹

In the spring of 1947, a year after becoming dean of the Stanford School of Engineering, Terman submitted a report on the school’s

37. Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford* (New York, 1993), 12.

38. Lowen, *Creating the Cold War University*, 31.

39. *Ibid.*, 67–75.

activities to President Tressider. Ordinarily, such reports focused on the obtainment and administration of resources, changes in the size and background of the student body, the nature of research undertaken by the faculty during the year, and rosters of faculty by department. Terman's report was different. More than a summary of activities from the previous academic year, it was also an argument about the future direction of the school. The report referred to the importance of the university's role in both attracting leading minds to the area and developing them. It referred to the importance of the university in fostering relationships with local industry and in attracting government-sponsored research. In these ways, Terman's 1947 report seems prescient, a document that speaks directly to the Silicon Valley of today and to its emulators: one of those rare cases in which a teleological approach—interpreting events of a half century ago in today's context—seems appropriate.

Not entirely. The most obvious exception is Terman's sense of regionalism, which flies in the face of today's spirit of globalism and which sounds provincial compared to the cosmopolitanism of today's Silicon Valley. This contrast between the imperatives of then and now comes across clearly in the first paragraph of Terman's report:

The West has long dreamed of an indigenous industry of sufficient magnitude to balance its agricultural resources. The war advanced these hopes and brought to the West the beginning of a great new era of industrialization. A strong and independent industry must, however, develop its own intellectual sources of science and technology, for industrial activity that depends upon imported brains and second-hand ideas cannot hope to be more than a vassal that pays tribute to its overlords, and is permanently condemned to an inferior competitive position.⁴⁰

Terman posited a role for Stanford as an anchor to a region that would spawn indigenous industry: "Our western universities, accordingly, have a responsibility to a growing industrial West. They can train the type of men required to exercise leadership in an expanding industry." This relationship should work both ways, Terman suggested: "If western industry and western industrialists are to serve their own enlightened and long-range interests effectively, they must cooperate with western universities and, wherever possible,

40. "Annual Report," Stanford University Archives, LD3002.A1 44TH 1946/47, p. 121.

strengthen them by financial and other assistance. Only in this way will it be possible to do the little bit extra that makes the difference between leadership and mediocrity.” Finally, Terman narrowed his frame to the stated subject of the report: “Stanford’s school of engineering has, as a major objective, service to the West.”⁴¹

Terman’s report represents a blueprint for the future relationship between the engineering school and local industry—a blueprint that Terman was already helping to make a reality. One striking aspect of Terman’s report is that it shows how well his school had established links with individuals representing homegrown technology companies. The electrical engineering department faculty included Leonard Fuller (onetime chief engineer of FTC), Norman Moore (future president of Litton Industries), and Edward Ginzton (future president of Varian Associates). Lecturers included William Hewlett and David Packard (founders of Hewlett-Packard) and Charles Litton (founder of Litton Industries).⁴²

Helping startups located on the Peninsula south of San Francisco, Terman advanced a model for what we now call knowledge-based industry, in contrast to the heavy industry that characterized mid-century American business. This model relied on proximity to a research university: “Industry is finding that, for activities involving a high level of scientific and technological creativity, a location in a center of brains is more important than a location near markets, raw materials, transportation, or factory labor.”⁴³ Instead of competing head-on with large firms in established industries, firms following Terman’s model would pursue safe niches and stay on the technological cutting edge.

The rise of the knowledge economy in Silicon Valley is said to have involved skipping the postagricultural stage of economic growth.⁴⁴ Yet, although the economic model Terman followed was quite different from the predominant industrial model in 1946, the forces that led to the rise of Silicon Valley were in many instances the same as those behind the rise of an industrial economy in the West—most notably, a sense of regional grievance and, therefore, of regional solidarity. Terman’s 1947 report shows the extent to which the rise of Silicon Valley took place in the context of a movement for

41. *Ibid.*

42. *Ibid.*, 127.

43. Quoted in Leslie and Kargon, “Selling Silicon Valley,” 437.

44. Roger Miller and Marcel Cote, “Growing the Next Silicon Valley,” *Harvard Business Review* (July–Aug. 1985): 114–23.

economic self-sufficiency in the West and was shaped by regional forces.

Regional Development—and Beyond

The decades from the 1950s through the 1990s saw the realization of many more of Terman's hopes than of his fears. The regional economy did not become a mediocrity. Stanford University did become an anchor of Silicon Valley, one of the world's great models for spawning indigenous high-tech industry. Faculty and students from Stanford's School of Engineering helped launch Varian Associates, Watkins-Johnson, and countless other companies. Ironically, one of the byproducts of Stanford's regional efforts was the elevation of the university's national and international reputation.

Some of the university's ancillary activities also had a regional focus. When Terman issued his report, Stanford Research Institute (SRI) had been in operation for about a year. SRI was founded in 1946 as a means for Stanford to assist the region's industries, as a source of possible research opportunities for Stanford faculty, and as a producer of additional revenue for the university.⁴⁵ Aside from the president of Stanford University, SRI's initial board of directors was composed entirely of executives of West Coast companies, from Union Oil to Southern Pacific to Crown Zellerbach.⁴⁶ The mission articulated in SRI's articles of incorporation included "the industrialization of the western United States of America."⁴⁷ It is a good thing that SRI's charter was so broad; during its first year in operation, less than 1 percent of its research expenditures went to projects sponsored by Bay Area-based firms.⁴⁸

Eastern industry had enjoyed access to the Mellon Foundation of Pittsburgh since 1911; SRI was one of seventy academic-affiliated institutes for industry-sponsored research founded between 1944 and 1947.⁴⁹ Several of these institutions, such as the Southern Research Institute (Birmingham, Alabama) and the Midwest Research Institute

45. Lowen, *Creating the Cold War University*, 77.

46. Stanford Research Institute, *Annual Report 1948*, inside cover, Stanford University Archives, SC 216, box 46, folder 2.

47. "Articles of Incorporation," p. 2, Stanford University Archives, SC 216, box B-14, folder 3.

48. "First Annual Report of the Stanford Research Institute to the Board of Directors," p. 7, Stanford University Archives, SC 216, box B-14, folder 4.

49. Lowen, *Creating the Cold War University*, 99.

(Kansas City, Missouri), aimed to serve industry removed from the East Coast. In 1945, the Los Angeles–based Pacific Research Foundation announced its mission to be “by and for the industries of the West.” The foundation’s prospectus pulled no regional punches. “No section of the country,” it said, “is so manifestly destined to be the future industrial empire as the Pacific Coast.”⁵⁰ SRI, however, never fulfilled its promise as a means of fostering relations between the university and industry; faculty objected to having industry set their research agenda.⁵¹

Finally, within the first decade after World War II, the university launched Stanford Industrial Park. Established as a means of generating income from Stanford’s vast land holdings, the park attracted a range of tenants from companies based all over the country. The park’s lasting impact came from local high-tech tenants such as Hewlett-Packard, Varian Associates, and Watkins-Johnson. As the emphasis of its tenants shifted from light manufacturing to research, the park’s name also changed. Stanford Research Park became yet another institution that would foster regional growth and another example of cooperation between the university and the region’s business community.

At the same time that Stanford’s role in the development of the western region began to take shape, the university’s self-definition was changing. As early as 1944, President Tressider noted in his annual report, “[The university] looks far beyond the confines of the campus or the local community. Stanford is not just a regional institution. . . . Its faculty is called upon to lend aid to both regional and national projects for governments, industry, and various social institutions.”⁵² After the end of the war, Stanford offered to provide a home base for the United Nations (losing out on the offer to the Rockefellers in New York City).⁵³ In late 1954 Stanford’s business manager, Alf Brandin, invited David Sarnoff to locate an RCA research laboratory in Stanford Industrial Park.⁵⁴ RCA, viewed as a predator by much of the local high-tech industry for decades, was asked to lie down with the lambs. In some ways, the regional solidar-

50. Attachment to 5 Sept. 1945 letter to David Jacobson, p. 1, Stanford University Archives, SC 216, box B-14, folder 15.

51. Lowen, *Creating the Cold War University*, 113–14.

52. “President’s Report (1943–44),” p. 9, Stanford University Archives, SC 151, box 16, folder 2.

53. Edwin Kiester, Jr., *Donald B. Tressider: Stanford’s Overlooked Treasure* (Stanford, Calif., 1992), 104.

54. Brandin to Sarnoff, 24 Nov. 1954, Stanford University Archives, SC 165, series I, box 4, folder 23.

ity of the West—and its role in the rise of Silicon Valley—appeared to be giving way to other imperatives.

A Legacy of Cooperation

The sense of cooperation in Silicon Valley extended beyond the relationship between the university and the business community. Several scholars, journalists, and business people have commented on the degree of cooperation among businesses in the Valley. In a study comparing Silicon Valley to Route 128 near Boston, AnnaLee Saxenian noted Silicon Valley's sense of cooperation among competing firms, behavior nearly absent on Route 128.⁵⁵ This was the paradox of Silicon Valley: simultaneous cooperation and competition.

Such cooperation appeared in various Valley industries, from instrumentation to semiconductors to computers.⁵⁶ Hewlett-Packard, for instance, became legendary for lending equipment or offering supplies to strapped startups. Varian's CEO told David Packard that his new company was out of various items. Packard responded by taking him to a storeroom and telling the manager, "Give this man anything he wants."⁵⁷ Packard also led the way in the establishment of industry associations, from WCEMA to the Silicon Valley Manufacturers Association. Several Silicon Valley executives have recounted their experiences of being assisted by industry competitors. Informal groups such as the Homebrew Computer Club became sources of information and advice for would-be entrepreneurs. Hang-outs such as the Wagon Wheel became places where semiconductor people gathered to trade war stories, to talk shop, or to gather job leads.⁵⁸

Certainly, the nature of the industry matters. For instance, the electronics industry is systems oriented, with very little vertical integration. The complex nature of the technology allows individual small firms to differentiate themselves sufficiently to capture their own niches but also forces them to rely on one another for sources of supply. Systems-oriented industry is also well suited to tremen-

55. Saxenian, *Regional Advantage*.

56. David Packard recalled: "Charlie Litton was a tremendous help in getting us started in production. He gave us access to his shop so we could do things we weren't able to accomplish in the garage on our own." This included use of the foundry and the engraving machine. Packard, *H-P Way*, 42–43.

57. Saxenian, *Regional Advantage*, 32; H. Myrl Stearns, interview with author, 15 June 2002.

58. Saxenian, *Regional Advantage*, 33, 34, 47.

dous labor mobility. In the Valley, loyalty to individual relationships often eclipsed loyalty to the firm. Furthermore, the area's "critical unit of production" has been the engineering team, a group that can move from firm to firm.⁵⁹

The Valley's cooperative ethos has appeared in other forms, as well, from law to venture capital. The environment in the Valley was less litigious than that of the electronics community in the East, focusing more on innovation and the creation of new enterprise than on patent protection.⁶⁰ As of the late 1980s, the Valley's biggest law firm, Wilson, Sonsini, Goodrich, and Rosati, controlled access to 60 percent of the Valley's venture capital, in some cases representing several firms that were direct competitors with one another.⁶¹

Organized venture capital in the Valley has cooperative roots. In the early 1960s, when Arthur Rock and Thomas Davis began their venture capital partnership, among their largest investors were local entrepreneurs such as Gordon Moore and Robert Noyce. As Martin Kenney and Richard Florida point out, Moore and Noyce assumed "a stake in the success of still more new firms," presumably including potential competitors.⁶² The importance to the region of the development of indigenous high-tech firms in Santa Clara County trumped any fears entertained by many local entrepreneurs about increased competition.

Cooperation is one of the hallmarks of an industrial district. A spirit of regional solidarity in the West contributed to Silicon Valley's sense of cooperation during its early years. Since the 1940s, increased ease of air travel, instant communication, and the proliferation of national and worldwide franchises have eroded regional definition in the United States. As early as the 1960s, observers such as Earl Pomeroy declared that the West was losing its distinctiveness in many ways.⁶³ Yet the paradox of Silicon Valley—its combination of competition and cooperation—remains, a Cheshire cat smile that is visible long after the body of regional grievance and solidarity has gone.

59. *Ibid.*, 43, 55.

60. *Ibid.*, 41.

61. Mark C. Suchman, "Dealmakers and Counselors," in *Understanding Silicon Valley*, ed. Kenney, 80; Jeffrey D. Saper, interview with author, 23 Aug. 2001.

62. Martin Kenney and Richard Florida, "Venture Capital in Silicon Valley: Fueling New Firm Foundation," in *Understanding Silicon Valley*, ed. Kenney, 108.

63. Earl Pomeroy, *The Pacific Slope: A History of California, Oregon, Washington, Idaho, Utah, and Nevada* (New York, 1965), 372.

Conclusion

In 1975 Terman spoke to a delegation visiting from China. In his speech, "Stanford Engineering and Local Industry," he detailed the various elements in the formula for Silicon Valley's success. "Many of the leaders and founders of the early companies were interested in building up the area," he explained. "As a result, they worked hard to create a community spirit such that individual companies, even companies that were competitors in the marketplace, would work together for the good of the area."⁶⁴ One wonders what his guests made of this information. Although the paradoxical combination of competition and cooperation appears to have contributed to Silicon Valley's success, such a combination may be difficult to import to a region; Silicon Valley already had a sense of regional solidarity before systematic attempts to create an industrial district.

Was the Silicon Valley paradox of competition and cooperation unique? A year after Terman's speech, Arthur Norberg suggested that, no, the region's development seemed to follow a more general model. In the West, the rise of electronics and the electrical industry were part of what Norberg termed "a four-stage process." The first stage is of particular relevance to regional solidarity: "As with all industrially emerging areas, the West experienced a period of economic colonialism, when the population was both aided and exploited by older, established eastern firms."⁶⁵

Other countries may find encouragement from knowing that regional solidarity can help accelerate the establishment of a Silicon Valley-like district. Furthermore, at least for intangibles, industrial districts are not necessarily self-contained. There is no shortage of countries—from India to Ireland to Israel—with areas that have a shared antagonism for another region or that have experienced a colonial relationship or at least "economic colonialism." Such an atmosphere may foster the necessary relationships among startups and between startups and a nearby academic anchor, facilitating the establishment of an industrial district.

What about the contemporaries or replicators of Silicon Valley? Perhaps the most revealing is New Jersey's attempt, with Terman's assistance, to replicate the Valley model.⁶⁶ Here was a region with a great technological tradition, from Edison to Bell Labs. The idea,

64. "Stanford Engineering and Local Industry," speech presented to Chinese visitors, p. 5.

65. Arthur L. Norberg, "The Origins of the Electronics Industry on the Pacific Coast," *Proceedings of the IEEE* 64 (Sept. 1976), 1315.

66. Kargon and Leslie, "Imagined Geographies," 129–30.

championed by Bell Labs, was to establish a graduate technical school to serve the major telecommunication, chemical, and pharmaceutical firms of New Jersey. Part of the reason this idea never came to fruition was a corporate culture of mistrust. As Leslie and Kargon put it, “vertically integrated corporations with strong in-house research and development laboratories and no tradition of cooperation” would not cooperate sufficiently to make this work. New Jersey firms had never experienced the sort of regional identification that the Silicon Valley pioneers embraced, a bond sufficient to convince competitors to cooperate. Regional development was not of inherent interest in New Jersey, nor could outsiders kindle that interest.⁶⁷

Another difference had to do with reference points. Princeton University, a possible regional anchor in the Stanford mold, viewed itself as in service to national, not regional, goals and expressed little interest in regional economic development, as demonstrated by the nature of Princeton’s Forrestal Research Center for aeronautics, chemistry, physics, and mathematics. Few of Forrestal’s corporate tenants were New Jersey firms, and those few were multinationals with concerns beyond the local region.⁶⁸ The reference points for Stanford University and for Fred Terman and his contemporaries in the 1940s included the Valley, the Peninsula, the Bay Area, and at its furthest reaches the Pacific Coast and the eleven states west of the Rockies. Not surprisingly, Stanford Industrial Park attracted more local firms than the Forrestal Research Center.

Some analyses of Silicon Valley’s success point to the Valley’s tradition of cooperation among individuals from various firms, even rivals for the same markets, and the construction of an “ecosystem” of infrastructure to support entrepreneurship.⁶⁹ These accounts have framed the Valley’s sense of cooperation in largely formulaic terms, suggesting that it was derived from either the nonintegrated nature of the Valley’s industries and their resulting reliance on local suppliers and customers, or the mobility of the Valley’s labor force, whose loyalties to individuals and to project teams trump loyalties to their own firms. This interpretation of the Valley’s cooperation among competitors tends to make cooperation appear as a stand-alone factor that those who wish to replicate Silicon Valley elsewhere could duplicate, rather than as a helpful cultural artifact of a particular time and place.

67. *Ibid.*

68. *Ibid.*

69. Stephen S. Cohen and Gary Fields, “Social Capital and Capital Gains: An Examination of Social Capital in Silicon Valley,” in *Understanding Silicon Valley*, ed. Kenney, 190–217; Saxenian, *Regional Advantage*; Tom Wolfe, “The Tinkerings of Robert Noyce: How the Sun Rose on the Silicon Valley,” *Esquire* (Dec. 1983), 346–74.

The attitudes of the administration and faculty of Stanford University and of the early entrepreneurs in the Valley may give pause to those attempting to replicate the Silicon Valley model. Establishing a high-tech region is difficult enough when trying to follow a particular formula; following a formula that does not take into account distinctive historical circumstances can lead to unrealistic expectations about the ability to replicate success. Others have made this case with respect to the Cold War and its associated opportunities for contracts and funding, as well as the contribution of FTC toward an already prepared environment in the Valley.⁷⁰ The regional ethos of the West of the first half of the twentieth century is yet another distinctive element in the creation of Silicon Valley and one that would-be replicators ignore at their peril.

70. Thomas Heinrich, "Cold War Armory: Military Contracting in Silicon Valley," *Enterprise & Society* 3 (June 2002): 247–84; Leslie, "The Biggest Angel of Them All," 48–67; Christophe Lécuycy, "Fairchild Semiconductor and Its Influence," in *The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship*, ed. Chong-Moon Lee et al. (Stanford, Calif., 2000), 158–83; Leslie, "How the West Was Won," 75–89; Leslie, *The Cold War and American Science*; Ann Markusen et al., *The Rise of the Gunbelt: The Military Remapping of Industrial America* (New York, 1991).

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