Stanford & Silicon Valley

SEEDS OF THE CHAIN OF EVENTS: CLUES FOR TODAY

1960

2020

D. B. Leeson, W6NL
Nov. 10, 2020 ©

W6YX Virtual Meeting
Silicon Valley: Big Started Small

- Recognized success, its economy > most nations
  - Most valuable companies, eminent research university
  - Wireless is key: Mobile accounts > world population, + WiFi

- How did this happen? It took 100 years
  - Started small: 1930s origins, just a few entities & individuals
  - Radio for Pacific shipping, microwaves for physics → radar

- Environment then: A period of great change
  - Depression (Stanford ↓), then WWII
  - Patent monopoly, but new physics

- Why here? Cooperative culture
  - Origin: Amateur radio
  - Fostered waves of innovation
    - Adapted to new opportunities
Silicon Valley Waves of Innovation

Fruit Orchards

Integrated Circuits

Personal Computers Life Sciences

Internet

Clean Tech

Wireless & Social Media

Popular View

Shockley

https://steveblank.com/secret-history/
Silicon Valley
Waves of Innovation

Real Story:
100 Years

“Silicon Valley”

Period of Focus

https://steveblank.com/secret-history/

Stanford University
Regional Advantage: The Culture

- Culture: Entrepreneurs Collaborate
  - OK to risk, change jobs, fail
  - Employees as partners, owners
  - Reliance on younger managers
  - Local support industry

- Stanford-industry partnership
  - Technology, entrepreneurship, patents
  - Microwave inventors: Bell Labs, MIT & Stanford

- Defense & NASA seed funding

- History of willing venture finance
  - Sponsors reinvest & mentor

- Climate & Land: room to grow

- 100-year history of success
  - Over many product life cycles
### Who Were the Pioneers?

**Who?**
- Cy Elwell
- Ralph Heintz 6AUC
- Fred Terman 6AE
- Charles Litton 6AO
- Bill Eitel 6UF
- J. McCullough W6CHE
- W.W. Hansen 6CSY
- Russell Varian
- David Packard 9DRV
- Bill Hewlett

**What?**
- Stanford, founded Federal Telegraph 1909
- Stanford BS, Heintz & Kaufman, vacuum tubes
- Stanford prof + WWII Radio Res. Lab (RRL)
- Stanford BS/MS: Vacuum tube volume mfg. technology, mentor, instructor; Federal spinoff
- Eimac: Heintz spinoff, vacuum tubes
- Stanford PhD/prof: “Founder of microwave electronics,” initiated linear accelerators
- Stanford BS/MS, Hansen roommate, inventor
- Stanford BS/MS/RA, HP founders
What Did They Contribute?

Cy Elwell
Federal: Poulson arc, de Forest tube, HF radio

Ralph Heintz 6XB
Gammatron invention, trained Eitel & McCullough, legal defeat of RCA

Fred Terman 6AE
Communications ➔ Stanford, lab, EE texts, aided Hansen microwave, WWII RRL “mgmt. postdoc,” postwar staff/$ ➔ Stanford

Charles Litton 6AO
Invented glass lathe, instructed & bought tube glass for all, sponsors Packard

Bill Eitel 6UF
Rugged ham power tubes ➔ 2 million tubes for WWII radar

J. McCullough W6CHE

W.W. Hansen 6CSY
Invents cavity resonator, klystron, linear accelerator, Doppler radar, NMR; $ ➔ Stanford; WWII Rad Lab/Sperry, postwar Microwave Lab

Russell Varian
Family patent tradition ➔ Stanford, invented klystron, founds Varian Assoc. 1948

David Packard 9DRV
Stanford RAs under Terman, Varian & Litton; oscillator patent, found HP 1939

Bill Hewlett
Stanford University
Role of Stanford Amateur Radio Club

- Marconi spark ➔ Poulson arc ➔ Shortwave
  - Hams confined to “200 meters & down,” discover it’s better
- Hoover, Jr., Litton, Packard: Active members
  - Hoover, Jr. 6XH: 1927 International Radiotelegraph Conf.
    - See C. P. Yeang, “Hobbyist experts,” H. Aitken, *Continuous Wave*
  - Packard: “No HP but for amateur radio and the club”
- Terman, Villard: Faculty advisors
- Ham radio launched my own career
Where Are We Headed?

- **Does the Silicon Valley model still work?**
  - Original culture & microwaves certainly helped me
  - Continuing new ideas & capital, but institutionalized
  - Complaints: Arrogant, insensitive, expensive & crowded?

- **Product life-cycle trends**
  - Few ➜ many  Big ➜ tiny  Fixed ➜ mobile  Novel ➜ commodity
  - Hardware ➜ software: Apps on existing infrastructure

- **Communications >> Transport**
  - Lower energy, instant, simultaneous multiple locations
  - Examples: Zoom, work at home, digital economy

- **Wireless is key to mobility, instant communications**
  - Internet of Things (IoT): Wireless-centered
  - Nanodevices: Trillions, run on harvested energy
Lessons for the Future

- **Pandemic & its impact on society & economy**
  - Suddenly changing many things
  - Discontinuities create opportunities
    - Newton to family farm in 1660 plague, discoveries re light, gravity
  - Do new opportunities parallel 1930s?

- **Silicon Valley: Monopolies, less cooperative culture**
  - Can culture be restored or look elsewhere?

- **Stanford: Now eminent, more conservative**
  - Less liberal invention & patent policies
  - Maintains entrepreneurial focus

- **Apply lessons from past to guide strategic choices**
  - What to study, how to find mentors, sponsors
  - New opportunities from discontinuities
  - Find a supportive culture
Links for Reference

- **The Uses of Amateur Radio**

- **A Personal View of Silicon Valley: The Central Role of Radio**
  - [https://www.dropbox.com/s/uldazyc0802agni/Radio%20Club%20of%20America_b.pdf?dl=0](https://www.dropbox.com/s/uldazyc0802agni/Radio%20Club%20of%20America_b.pdf?dl=0)

- **Microwaves from Stanford to Silicon Valley**
  - [https://ethw.org/w/images/9/9c/Presentation20160210-Leeson.pdf](https://ethw.org/w/images/9/9c/Presentation20160210-Leeson/pdf)

- **Microwaves and Silicon Valley**
  - [https://www.dropbox.com/s/30wnmsu8jd64zwI/Microwaves%20and%20Silicon%20Valley_sm.pdf?dl=0](https://www.dropbox.com/s/30wnmsu8jd64zwI/Microwaves%20and%20Silicon%20Valley_sm.pdf?dl=0)

- **"Two Days in August"**
  - [https://www.dropbox.com/s/nbrm8rbezcjvgu5/Two%20Days%20in%20August5.pdf?dl=0](https://www.dropbox.com/s/nbrm8rbezcjvgu5/Two%20Days%20in%20August5.pdf?dl=0)

- **"Role of Defense Funding in the Making of Silicon Valley"**

- **Gillmor "The 'Prehistory' of Silicon Valley"**
  - [https://www.dropbox.com/s/jnsaqbd8atj2juu/The%20%22Prehistory%22%20of%20Silicon%20Valley.pdf?dl=0](https://www.dropbox.com/s/jnsaqbd8atj2juu/The%20%22Prehistory%22%20of%20Silicon%20Valley.pdf?dl=0)

- **Wesling "The Origins of Silicon Valley: Roots in Ham Radio"**

- **Blank "Secret History of Silicon Valley"**
  - [https://steveblank.com/secret-history/](https://steveblank.com/secret-history/)

- **“Silicon Valley Was Built On Tubes of Glass”**
  - [https://hackaday.com/2017/11/02/silicon-valley-was-built-on-tubes-of-glass/](https://hackaday.com/2017/11/02/silicon-valley-was-built-on-tubes-of-glass/)
Additional References

- Norberg, “The Origins of the Electronics Industry on the Pacific Coast”
  › https://ieeexplore.ieee.org/document/1454590

- Leslie “How the West Was Won: The Military and the Making of Silicon Valley”
  › https://ethw.org/w/images/0/0b/Leslie%2C_How_the_West_Was_Won.pdf

- Leslie "Playing the education game to win: the military and interdisciplinary research at Stanford,”
  › https://www.jstor.org/stable/27757596

- Leslie and Kargon, "Selling Silicon Valley: Frederick Terman’s model for regional advantage,”

- Adams "Regionalism in Stanford's contribution to the rise of Silicon Valley;" “Before the garage: the innovation system that produced Silicon Valley;” “Stanford and Silicon Valley: Lessons on becoming a high-tech region;” “Stanford University and Frederick Terman's blueprint for innovation in the knowledge economy;” “Follow the money: Engineering at Stanford and UC Berkeley during the rise of Silicon Valley;” “Growing where you are planted: Exogenous forces and the seeding of Silicon Valley”
  › http://faculty.salisbury.edu/~sbadams/research.htm

- Adams "Arc of Empire: The Federal Telegraph Company, the U.S. Navy, and the Beginnings of Silicon Valley”
Books and Courses


Course: Perspectives on Silicon Valley


Author Note: There are many other presentations, papers, books and online references about the history of Silicon Valley. The author acknowledges access to many more than are listed here, as well as in-person access to archives at Stanford, MIT, National Archives, Hagley Library, and other online archives too numerous to detail here. Also, discussions with authors and archivists are gratefully acknowledged, as is the opportunity to experience personally over sixty years of the emergence of Silicon Valley.