CHEMICAL HERITAGE FOUNDATION

THOMAS E. EVERHART

Transcript of an Interview
Conducted by
David C. Brock and Cyrus Mody

As a phone interview and in
Santa Barbara, California

on
28 March 2007 and 3 May 2011

(With Subsequent Corrections and Additions)
ACKNOWLEDGMENT

This oral history is part of a series supported by grants from the Gordon and Betty Moore Foundation. This series is an important resource for the history of semiconductor electronics, documenting the life and career of Gordon E. Moore, including his experiences and those of others in Shockley Semiconductor, Fairchild Semiconductor, Intel, as well as contexts beyond the semiconductor industry.

This oral history is made possible through the generosity of the Gordon and Betty Moore Foundation.
CHEMICAL HERITAGE FOUNDATION
Oral History Program
FINAL RELEASE FORM

This document contains my understanding and agreement with Chemical Heritage Foundation with respect to my participation in the audio-recorded interview conducted by

David C. Brock on 28 March 2007

I have read the transcript supplied by Chemical Heritage Foundation.

1. The audio recording, corrected transcript, photographs, and memorabilia (collectively called the "Work") will be maintained by Chemical Heritage Foundation and made available in accordance with general policies for research and other scholarly purposes.

2. I hereby grant, assign, and transfer to Chemical Heritage Foundation all right, title, and interest in the Work, including the literary rights and the copyright, except that I shall retain the right to copy, use, and publish the Work in part or in full until my death.

3. The manuscript may be read and the audio recording(s) heard by scholars approved by Chemical Heritage Foundation subject to the restrictions listed below. The scholar pledges not to quote from, cite, or reproduce by any means this material except with the written permission of Chemical Heritage Foundation.

4. I wish to place the conditions that I have checked below upon the use of this interview. I understand that Chemical Heritage Foundation will enforce my wishes until the time of my death, when any restrictions will be removed.

Please check one:

a. __________  No restrictions for access.

NOTE: Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation Oral History Program to obtain permission from Chemical Heritage Foundation, Philadelphia, Pennsylvania.

b. __________  Semi-restricted access. (May view the Work. My permission required to quote, cite, or reproduce.)

c. __________  Restricted access. (My permission required to view the Work, quote, cite, or reproduce.)

This constitutes my entire and complete understanding.

(Signature) Thomas E. Everhart

(Date) Sept 2, 2007

Revised 10/11/05
This interview has been designated as **Semi Restricted Access**.

One may view the oral history. However, the permission of the interviewee is required to quote from, cite, or reproduce the oral history.

*Please contact CHF to request permission.*

The Chemical Heritage Foundation (CHF) serves the community of the chemical and molecular sciences, and the wider public, by treasuring the past, educating the present, and inspiring the future. CHF maintains a world-class collection of materials that document the history and heritage of the chemical and molecular sciences, technologies, and industries; encourages research in CHF collections; and carries out a program of outreach and interpretation in order to advance an understanding of the role of the chemical and molecular sciences, technologies, and industries in shaping society.
THOMAS E. EVERHART

1932  Born in Kansas City, Missouri, on 15 February

Education

1953  A.B., Harvard College, Physics
1955  M.Sc., University of California, Los Angeles, Applied Physics
1958  Ph.D., Clare College, University of Cambridge, Engineering

Professional Experience

Hughes Aircraft Company, Research and Development Laboratories
1953-1955  Member of the Technical Staff, research on microwave tubes

Watkins-Johnson Company
1960  Research and development, microwave electron tubes
1960-1961  Consultant, mm-wave low noise tubes

Westinghouse Research Laboratories
1961  Research and development, electron beams as applied to semiconductor analysis and fabrication

Ampex Research and Development Laboratories
1961-1970  Consultant, electron beam recording

Hughes Research Laboratory
1965-1980  Consultant, problems of electron optics and electron physics

University of California, Berkeley
1958-1962  Assistant Professor, Electrical Engineering
1962-1967  Associate Professor, Electrical Engineering and Computer Science
1967-1978  Professor, Electrical Engineering and Computer Science
1972-1977  Department Chairman, Electrical Engineering and Computer Science

Cornell University
1979-1984  Professor, Electrical Engineering and Applied Physics and Joseph Silbert Dean of Engineering

University of Illinois, Urbana-Champaign
1984-1987
Chancellor and Professor of Electrical and Computer Engineering
California Institute of Technology

1987-1997
President and Professor, Electrical Engineering and Applied Physics
1997-present
Board of Trustees
University of Cambridge
1998
Pro-Vice-Chancellor

**Leadership Positions**

Lawrence Berkeley Laboratory
1978-1985
Scientific and Educational Advisory Committee
1980-1985
Chairman, Scientific and Educational Advisory Committee

Yale University
1983-1985
Council Committee on Physical Science and Engineering

National Research Council, Commission on Engineering and Technical Systems
1984-1986
Engineering Research Board

State of Illinois
1985-1987
Steering Committee for the Superconducting Super Collider

National Association of State Universities and Land Grant Colleges
1986-1987
Commission on Education for the Engineering Professions, Class of 1987

U.S. Department of Energy
1987-1988
Site Selection Committee for the Superconducting Super Collider

General Motors
1980-1989
Scientific Advisory Committee
1984-1989
Chairman, Scientific Advisory Committee
1989-2002
Board of Directors

R. R. Donnelly
1981-1989
Technical Advisory Council

KCET
1989-1997
Board of Directors
Council on Competitiveness
1989-1999 Executive Committee
1990-1996 Vice Chairman
The Franklin Institute
1989-1992 Board of Advisors, The Bower Award and Prize for Achievement in Science, the Benjamin Franklin National Memorial

United States Department of Energy
1990-1993 Chairman, Secretary of Energy Advisory Board

Corporation for National Research Initiatives
1990-present Board of Directors

Hewlett Packard Company
1991-1999 Board of Directors

Reveo, Inc.
1994-2002 Board of Directors

Saint-Gobain Company
1996-2008 Board of Directors

Australian National University
1997-2001 Advisory Council, Institute of Advanced Studies

Raytheon Company
1997-2006 Board of Directors

California Institute of Technology
1998-present Board of Directors

Electric Power Research Institute
1998-2002 Board of Directors

Hughes Electronics Corporation
1998-2002 Board of Directors

Harvard University
1999-2005 Board of Overseers
2004-2005 President of Board of Overseers

Agilent Technologies
1999-2002 Board of Directors

Acorn Technology
2001-present Board of Directors
Kavli Foundation
2001-present Board of Directors and Investment Committee
Novelx
2006-2010 Board of Directors
W. M. Keck Foundation
1998-present Senior Scientific Advisor
2007-present Board of Directors

Visiting Professorships

Institüt für Angewandte Physik
1966-1967 Guest Professor

Waseda University
1974 Visiting Professor, Applied Physics

Osaka University
1974 Visiting Professor, Applied Physics

Clare Hall, Cambridge
1975 Visiting Fellow

Honors

1949-1953 William Scott Gerrish Scholarship, Harvard College
1953 Phi Beta Kappa
1953 Sigma Xi Associate Member
1953 A.B. Magna cum laude qui adseculus est summos honores
1958 Sigma Xi, University of California, Berkeley
1962 Distinguished Teaching Award, University of California, Berkeley
1966-1967 National Science Foundation Senior Post-doctoral Fellowship
1969 Fellow, Institute of Electrical and Electronics Engineers
1969-1970 Miller Research Professor, University of California, Berkeley
1974-1975 John Simon Guggenheim Memorial Fellowship
1978 National Academy of Engineering
1984 IEEE Centennial Medal
1984 Scientific Member, Böhmische Physical Society
1988 Fellow, American Association for the Advancement of Sciences
<table>
<thead>
<tr>
<th>Year</th>
<th>Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>ASEE Benjamin Garver Lamme Award</td>
</tr>
<tr>
<td>1990</td>
<td>Honorary Doctor of Laws, Illinois Wesleyan University</td>
</tr>
<tr>
<td>1990</td>
<td>Honorary Doctor of Laws, Pepperdine University</td>
</tr>
<tr>
<td>1990</td>
<td>Honorary Doctor of Engineering, Colorado School of Mines</td>
</tr>
<tr>
<td>1990</td>
<td>Microbeam Analysis Society Presidential Science Award</td>
</tr>
<tr>
<td>1990</td>
<td>Foreign Member, Royal Academy of Engineering</td>
</tr>
<tr>
<td>1992</td>
<td>Clark Kerr Award, University of California, Berkeley</td>
</tr>
<tr>
<td>1993</td>
<td>Professional Achievement Award, Alumni Association, University of</td>
</tr>
<tr>
<td></td>
<td>California, Los Angeles</td>
</tr>
<tr>
<td>1993</td>
<td>ASEE Centennial Medallion</td>
</tr>
<tr>
<td>1995</td>
<td>Founder’s Award, Energy and Resources Group, University of California,</td>
</tr>
<tr>
<td></td>
<td>Berkeley</td>
</tr>
<tr>
<td>2002</td>
<td>IEEE Founders Medal</td>
</tr>
<tr>
<td>2002</td>
<td>Okawa Prize</td>
</tr>
</tbody>
</table>
ABSTRACT

**Thomas E. Everhart**’s oral history begins with a discussion of his work with the scanning electron microscope (SEM). Everhart talks about Gordon E. Moore’s contributions to the electronics world. He describes his time as president of California Institute of Technology (Caltech). At the end of the first session, Everhart discusses his admiration for Moore.

His second interview starts with his childhood in Missouri. He discusses his family, hobbies, and school. He talks about work, the Methodist Youth Fellowship, where he met his future wife, and his desire to go to Harvard.

Everhart entered Harvard University and shortly after starting was offered the Gerrish Scholarship, for all four years. At Harvard he played intramural basketball; was active in the Wesley Foundation; helped found the Crimson Key Society; and became engaged. He majored in physics, helped set up laboratories, but had no opportunities for research. After graduation he went to University of California, Los Angeles (UCLA) for a master’s degree, in conjunction with Hughes Aircraft Company, where he focused on applied physics and engineering. There he first began working with electron beams. For his PhD he went to Clare College, University of Cambridge, funded by Marshall Scholarship, and working in Charles W. Oatley’s lab. His dissertation dealt with SEM contrast formation, observed voltage contrast across P-N junctions, and explored potential applications.

PhD in hand, Everhart became an assistant professor of electrical engineering at University of California, Berkeley. Initially working on microwave tubes. With Donald O. Pederson and Paul L. Morton, they founded the first integrated circuit (IC) lab. During his years at Berkeley, Everhart consulted for Watkins-Johnson, Ampex, Westinghouse Research Laboratories, and Hughes Aircraft Company. He took leave to help Oliver Wells build a SEM at Westinghouse Research Labs. He built his own SEM, the first with transistorized circuits. He had funding from the Air Force, the National Institutes of Health (NIH); and from the National Science Foundation (NSF). He also progressed to full professor and then to chairman of the electrical engineering and computer science (EECS) department. While he was chairman of EECS, the NSF wanted to establish an accessible microfabrication facility. Berkeley did not take advantage of this opportunity, instead the lab went to Cornell University.

Everhart left Berkeley to become Dean of Engineering at Cornell University. He felt he greatly improved the engineering college’s morale, faculty, and financial position. During his tenure, the Knight Laboratory, the Snee building, and the Pew Engineering Quadrangle were dedicated. He worked on the advisory committee for the submicron facility, funded by NSF. After six and a half years at Cornell, Everhart was offered the chancellorship of the University of Illinois. There he started new programs, helped get personal computers for faculty, and improved the facilities for semiconductors. He also encouraged the founding of the Beckman Institute.

After three years, Everhart was chosen to be president of Caltech, a position he held for ten years. At Caltech he was also on the advisory committee for micro devices at the Jet Propulsion Laboratory (JPL). Throughout the interview Everhart explains his relationships with many scientists and their work. He remains amazed by the speed of evolution of transistors to integrated circuits and he exclaims over the continued validity of Moore’s Law.
INTERVIEWERS

David C. Brock is a senior research fellow with the Center for Contemporary History and Policy of the Chemical Heritage Foundation. As an historian of science and technology, he specializes in oral history, the history of instrumentation, and the history of semiconductor science, technology, and industry. Brock has studied the philosophy, sociology, and history of science at Brown University, the University of Edinburgh, and Princeton University (respectively and chronologically). His most recent publication is *Understanding Moore’s Law: Four Decades of Innovation* (Philadelphia: Chemical Heritage Press), 2006, which he edited and to which he contributed.

Cyrus Mody teaches the history of science, technology, and engineering at Rice University. His own research focuses on the history of very recent physical and engineering sciences (~1970 to the present), with particular emphasis on the creation of new communities and institutions of research in the late Cold War and the post-Cold War periods, especially in fields related to the semiconductor industry. His book, *Instrumental Community: Probe Microscopy and the Path to Nanotechnology* (2011, MIT Press) explores the co-evolution of an experimental technology (the scanning tunneling microscope and atomic force microscope and their variants) and the community of researchers who built, bought, used, sold, theorized, or borrowed these instruments. Currently, he is working on a history of the communities and institutions of nanotechnology, in collaboration with colleagues at the Center for Nanotechnology in Society at the University of California – Santa Barbara, the Chemical Heritage Foundation in Philadelphia, and at Rice.
TABLE OF CONTENTS

Early Research 1

Leadership and Management 9

After California Institute of Technology 19
   The Moore Foundation’s impact on Caltech.

Childhood 23
   Growing up. Family life. Hobbies, sports, faith, and work. Education.

College Years 28

Graduate School Years 40

First Academic Job 59

Cornell University Years 86

University of Illinois 94

President of California Institute of Technology (Caltech) 97
   President. Advisory committee at JPL. Nanotechnologies advancing.
Thoughts about Small

Index
INDEX

A
Adesida, Ilesamni, 123
Ahmed, Haroon, 73
Alberts, Larry, 18
Alberts, Richard, 81
AMPEX, 93, 102
Angelakos, Diogenes J., 111
Aplysia californica, 100
Apple, Inc., 115
Arizona State University, 123
Arkansas, 48
Atomic Energy Commission, 71
Australia, 68

B
Bair, Glenn O., 51, 53
Bakish, Robert A., 72, 83
Ballantyne, Joseph M., 111, 112, 126
Baltimore, David, 33
Baltimore, Maryland, 17
Baños, Alfredo, Jr., 60
Bardeen, John, 125
Bechtel, Stephen D., 28
Beck, A.H.W., 73
Becker, George, 81
Beckman Institute, 34
Beckman, Arnold O., 34, 35
Beer, Samuel Arnold H., 57, 58
Belgium, 72
Bell Laboratories, 21, 22, 26, 66, 90, 104, 107, 108, 109, 123
Beloit, Kansas, 54
Beowulf, 57
Berlin, West Germany, 80
bin Laden, Osama, 94
Binnig, Gerd, 128
Birdsall, Charles K., 61, 64, 65
Block, Eric, 116, 117
Bloombergen, Nicolaas, 56
Boston, Massachusetts, 48, 52, 54
Boulder, Colorado, 67, 112
Bourne, Henry, Jr., 113
Boyd, Alan, 67
Brewer, George, 61
Broers, Sir Alec, 21, 68, 105
Brookline, Massachusetts, 51
Burns, Rev. Jackson, 55

C
California, 93, 100, 107, 123
California Institute of Technology, 15, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 36, 37, 38, 39, 50, 59, 60, 61, 66, 80, 109, 117, 122, 123, 124, 127, 128, 130, 132
Caltech. See California Institute of Technology
Cambridge Instruments, 92, 98
Cambridge, England, 56, 92
Cambridge, Massachusetts, 52, 92
Canalco, 99
Cannon, Robert H., Jr., 27
Carnegie Institute of Technology, 88
Carnegie Mellon University, 87
Castaining, Raimond, 71
Cavendish Laboratory, 66, 70
Chameau, Jean-Lou, 33
Champaign-Urbana, Illinois, 28
Chicago, Illinois, 47, 48
Chillicothe, Missouri, 41, 42, 49
China, 89, 133
Churchill College, 68
Classical Mechanics, 60
Cleveland, Ohio, 28
Colorado, 28, 48
Concord, Massachusetts, 52
Concord, New Hampshire, 108
Cornell University, 26, 27, 60, 68, 90, 109, 111, 112, 113, 114, 116, 117, 118, 119, 120, 122, 123, 124, 125, 127, 131
Cortland County, New York, 123
Cosslett, Vernon E., 70, 71, 73
Crewe, Albert V., 112
Crimson Key, 55
Cultural Revolution, 89
Currie, Malcolm R., 62, 64, 81

D
Dalman, G. Conrad, 120
DARPA. See Defense Advanced Research Projects Agency
Dartmouth College, 92
Davis, Robert, 18
Defense Advanced Research Projects Agency, 26, 27, 114
DNA, 110, 130
Duncumb, Peter, 70, 71
EBIS. See electron beam imaging system

Egypt, 132

Eigler, Don, 130
electron beam, 16, 20, 21, 22, 63, 64, 70, 71, 72, 76, 
77, 82, 93, 95, 103, 104, 105, 106, 107, 109, 113, 
126, 132
electron beam imaging system, 21, 104, 108
electron microscopy, 66, 70, 71, 72, 73, 80, 101, 131, 
132
Electron Microscopy Society of America (EMSA), 105
Emporia College, 48
Emporia, Kansas, 49, 52
England, 50, 57, 62, 66, 67, 68, 92
English Village, 57
Europe, 71
Evans and Sutherland Computer Corporation, 127
Everhart, Betty Ann (sister), 42
Everhart, Carol Diane (sister), 42
Everhart, Doris (wife), 61, 88
Everhart, Elizabeth Ann West (mother), 40
Everhart, Mamie (paternal grandmother), 40
Everhart, William Elliott (father), 40

Fainsod, Merle, 57
Fairchild Company, 24
Fairchild Semiconductor, 16, 20, 22, 23, 24, 74, 107, 
116
Fieser, Louis F., 55
Forrest, Anne, 88
Forrest, Michael, 88
France, 71
Fujikawa, Dr., 43
gallium phosphide, 77
Genentech, 31
General Electric, 25, 72
Germany, 50, 104, 116
Gibbons, James F., 88, 89, 90, 118
Gibbons, Lynn, 88
Gibson, Harry C., 51
Girard High School, 43, 45
Girard, Kansas, 43, 44, 46, 47, 49
Goldstein, Herbert, 60
Google, 116
Google Earth, 94
Gordon and Betty Moore Foundation, 36
Gordon Research Conferences, 108, 109
Grandview, Missouri, 40, 41
Gray, William (maternal half-uncle), 40
Greenberg, Donald P., 127
Grey, Pearl Zane, 44
Grove, Andrew S., 16, 20, 23, 24, 25, 26, 107

H
Haag, Clinton (maternal half-aunt), 40
Haeff, Andrew V., 59
Harris, Jay H., 113
Harvard University, 40, 45, 46, 47, 48, 49, 50, 51, 
52, 53, 54, 55, 57, 58, 62, 92, 122
Hatzakis, Michael, 109
Hawaii, 38, 123
Heilmeyer, George H., 114
Herzog, Richard, 103
Hewlett Packard, 24, 26, 30
Hodges, David A., 19, 111, 124
Holland, 56, 71
Holonyak, Nick, Jr., 125
Homans, George C., 57
Houghton Mifflin Press, 52
HP. See Hewlett Packard
Hu, Evelyn, 109
Hughes Aircraft Company Research and Development Laboratories, 56, 58, 60, 61, 62, 63, 
64, 66, 70, 75, 81, 90, 102, 108, 123
Huscher, John D., 87
IBM. See International Business Machines
IC. See integrated circuit
IEEE. See Institute of Electrical and Electronics
Engineers
Institute of Electrical and Electronics Engineers, 72
integrated circuit, 15, 16, 17, 18, 19, 20, 21, 22, 23, 
24, 25, 26, 35, 74, 77, 81, 82, 85, 86, 95, 96, 97, 
99, 101, 102, 103, 107, 109, 110, 111, 124, 126, 
130, 131
Intel, 16, 22, 23, 24, 25, 26, 29, 32, 38, 96, 107, 109, 
115
International Business Machines, 21, 22, 26, 68, 105, 
107, 109, 110, 116, 117, 123, 130
International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication 
(EIPBN), 105, 106, 108, 109
Iowa, 62
Isaacson, Michael S., 112, 120
Ithaca, New York, 50, 119

J
Japan, 50, 68, 101, 108, 114, 133
Japanese Ministry of International Trade and Industry, 114
JEOL, Ltd., 98
Johnson, H. Richard, 59, 61, 64, 75, 91
JPL. See National Aeronautics and Space Administration: Jet Propulsion Laboratory

K
Kaczynski, Ted [Unabomber], 111
Kansas, 45, 48, 62
Kansas City, Missouri, 40, 41, 42, 44, 49, 54
Kansas State Teachers College, 43
Kennedy, W. Keith, 119
Keyes, Robert W., 109
Kittel, Charles, 56
klystrons, 64, 65
Kompfner, Rudolf, 66
Kraft Foods Company, 41
Kuckenen, Carl, 127

L
Lake Michigan, 48
Langenberg, Don, 61
Langer, James S., 87
laser interferometry gravity wave observatory (LIGO), 130
Lawrence Berkeley National Laboratory, 124
Lawrence, Kansas, 51, 52
Le Poole, J.B., 71
Lewis, Edwin R., 100
Lichtenberg, Allan J., 58
Lincoln Laboratory, 93
Linvill, John, 89
lithography, 21, 22, 93, 103, 104, 105
Los Angeles, California, 27, 59

M
MacDonald, Noel C., 16, 21, 99, 107, 109, 120, 122, 124
MacIntosh, Ian, 18
March, Adrian, 15, 73
Marshall Scholarship, 62, 88
Martin City, Missouri, 41, 44, 49
Marton, Clara, 72
Marton, Louis L., 72
Maslach, George J., 111
Massachusetts Institute of Technology, 56, 92, 93, 108, 112, 119
Mayer, Betty, 123
Mayer, James W., 122
McMullan, Dennis, 67, 69, 70, 79
Mead, Carver A., 26, 27, 109, 114
Meieran, Eugene S., 106, 107
Meindl, James D., 96
Mettler, Donna, 28
Mettler, Ruben F., 28, 29, 30
microfabrication, 106, 108, 109, 111, 125, 129
microwave tubes, 56, 59, 61, 63, 65, 81, 91
Military Authorization Act
Mansfield Amendment, 111
Mill, John Stuart, 57
Minnesota, 122
Mississippi River, 42, 48
Missouri, 48
MIT. See Massachusetts Institute of Technology
Moellenstedt, G., 104
Montana, 51, 111
Moore, Betty L., 32, 37, 38
Moore, Gordon, 15, 16, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 107, 119
Moore’s Law, 22, 25, 104, 130
Morton, Paul L., 18, 81, 82
MOS. See transistors
Mt. Vernon, Missouri, 42
Müller, Erwin W., 128

N
nanofabrication, 110, 114
nanotechnology, 114, 116, 129, 130, 132
NASA. See National Aeronautics and Space Administration
National Academy of Engineering, 59
National Academy of Sciences, 59, 88
National Aeronautics and Space Administration, 127
Jet Propulsion Laboratory, 66, 127, 128
National Bureau of Standards, 72
National Geospatial-Intelligence Agency, 94
National Institute of General Medical Sciences, 100
National Institutes of Health, 100, 101
National Science Foundation, 100, 101, 111, 112, 113, 114, 117, 125, 126
Needham, Tom, 43
New York, 119, 123
Nigeria, 124
NIH. See National Institutes of Health
Nixon, William C., 68
Nobel Prize, 33, 35, 55, 56, 130, 131, 132
North American Rockwell, 122
Noyce, Robert N., 16, 24, 26, 35, 74, 107
NPN junction diode, 77
NSF. See National Science Foundation
nuclear magnetic resonance, 55

O
Oatley, Sir Charles W., 65, 66, 67, 73, 74, 91
Obama, President Barack H., 132
Oklahoma, 48
Oldham, William G., 96
*Only the Paranoid Survive*, 25

P

Pakistan, 94
Palm Springs, California, 32
Parke, Charles D., 51
passivation, 16, 74, 77
patents, 21, 65, 91, 92
Pease, R. Fabian W., 21, 68, 90, 99, 104, 108
Pederson, Donald O., 18, 19, 81, 82, 102
Peierls, Rudolf E., 88
Perkin-Elmer Corporation, 122
Peterson, Rudy, 98
Pfeiffer, Hans C., 21
Philadelphia, Pennsylvania, 83, 124
Pierce, John R., 64, 66
*Piers Plowman*, 57
Pittsburgh, Kansas, 43
Pittsburgh, Pennsylvania, 17, 88
PN junction diode, 74, 75, 76, 77, 81, 132
PNP junction diode, 77
polio, 54
Post Office Telephone Laboratory, 78
President’s Science Advisory Committee, 132
Princeton University, 123
Purcell, Edward M., 55, 56

Q

Quate, Calvin F., 128

R

Radio Corporation of America, 72
Ramo, Simon, 28, 59, 72
Ramo-Wooldridge Corporation, 59
RCA. *See* Radio Corporation of America
religion, 44, 45, 47, 51, 55
Rhode Island, 51
Rhodes Scholarship, 62
Rohrer, Heinrich, 128
Russia, 57

S

Sack, Edgar A., 18
San Francisco, California, 19, 37, 38, 108
Santa Barbara, California, 37
Santa Cruz, California, 37
Santa Monica, California, 60
scanning electron microscope, 15, 16, 17, 66, 67, 68, 70, 71, 73, 75, 78, 79, 81, 82, 85, 90, 91, 98, 101, 103, 106, 107
Schwartz, Charles, 110
Scroope House, 67, 69
SEM. *See* scanning electron microscope
SEMATECH, 113, 114
Shockley Semiconductor, 35
Shockley, William H., 35
Shoulders, Ken, 92, 128
Siegman, Anthony E., 58, 61, 64, 89, 90
Simulation Program with Integrated Circuit
Emphasis (SPICE), 19, 102
Skilling, Hugh H., 89
Slichter, Charles P. (maternal cousin), 40
Slichter, Edith (maternal grandmother), 40, 42
Slichter, Sumner (maternal cousin), 40
Smith, George, 61
Smith, Henry I., 108
Smith, Kenneth C.A., 67, 69, 70, 73, 75
Smoke Tree Ranch, 32
Spreadbury, Peter J., 67, 78, 84
SRC, 114
SRI. *See* Stanford Research Institute
St. Joseph, Missouri, 42
Stalin, Joseph V., 57
Stanford Research Institute, 92, 93
Stanford University, 21, 31, 56, 58, 61, 62, 65, 66, 68, 88, 89, 90, 96, 107, 114, 118, 128
State University of New York College at Cortland, 123
Sterling, John Ewart Wallace, 62
Sternglass, Ernest, 87
Stewart, A.D. Gary, 68
Stopenhagen, Rev. Paul, 55
Summerfield Scholarship, 51
Sun Microsystem, 116
Sutherland, Ivan E., 26, 27, 114
Switzerland, 128
Syracuse University, 124
Syracuse, New York, 124

T

Tarzan, 44
Tempe, Arizona, 123
tenure, 30, 33, 112, 122
*The Accidental Entrepreneur*, 30
Thomas, Gareth, 15, 21, 106
Thompson Products, 59
Thompson Ramo-Wooldridge Incorporated, 28, 59
Thompson, Larry F., 109
Thorne, Kip S., 130
Thornley, Richard F.M., 67, 79
Three-Beams. *See* International Conference on
Electron, Ion, and Photon Beam Technology and Nanofabrication (EIPBN)
transistors, 16, 20, 21, 23, 25, 69, 74, 75, 78, 97, 98, 101, 107
Truman, President Harry S., 40
Turing, Alan M., 73

U
U.S. Congress, 113
UCLA. See University of California, Los Angeles
UCSB. See University of California, Santa Barbara
Unabomber, 111
United Kingdom, 74
United States of America, 43, 45, 56, 71, 72, 74, 81, 82, 88, 98, 101, 114, 118, 124, 132, 133
University of Birmingham, 88
University of California, Los Angeles, 58, 59, 60, 61, 62, 100
University of California, Santa Barbara, 88, 124
Institute for Theoretical Physics, 88
University of Cambridge, 15, 60, 63, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 78, 80, 82, 83, 84, 88, 89, 90, 91, 92, 99
University of Chicago, 112
University of Illinois, 26, 27, 34, 40, 90, 109, 118, 122, 123, 124, 125
University of Kansas, 51
University of Pennsylvania, 132
University of Pittsburgh, 87
University of Southern California, 59, 71
USC. See University of Southern California

V
very large scale integration, 114
Virginia Polytechnic Institute, 121

VSLI. See very large scale integration

W
W.K. Kellogg Company, 41
W.M. Keck Foundation, 32, 59, 132
Washington, D.C., 111, 131
Watkins, Dean A., 59, 61, 64, 89
Watkins-Johnson Company, 59, 91
Wayland, Walter, 43
Wells, Oliver, 15, 67, 73, 77, 78, 82, 99, 101, 106
WesleyFellowship, 55
West, Faith Arlene (maternal aunt), 40
West, John (maternal uncle), 40
Westinghouse Research Laboratories, 15, 16, 17, 18, 22, 25, 50, 77, 82, 83, 84, 85, 86, 87, 95, 96, 98, 99, 101
Wharton, Ralph N., 51
Whinnery, John R., 61, 62, 81, 88, 89
Wichita High School East, 45, 49
Wichita, Kansas, 45, 46, 49, 51, 53, 54
William Scott Gerrish Scholarship, 52
Wittry, David B., 71
Wolfboro, New Hampshire, 108
Wong, Theodore, 60
Wooldridge, Dean E., 59
World War II, 42, 69, 73
Wright Patterson Air Force Base, 18, 81, 100

Y
Yates, James, 65

Z
Zewail, Ahmed H., 131
Zworykin, Vladimir K., 72