

CHEMICAL HERITAGE FOUNDATION

**JAMES R. VON EHR, II**

Transcript of an Interview  
Conducted by

David C. Brock

at

Zyvex Labs, Inc.  
Richardson, Texas

on

24 January 2011

(With Subsequent Corrections and Additions)

## **ACKNOWLEDGEMENT**

This oral history is part of a series supported by the Center for Nanotechnology in Society (CNS), University of California, Santa Barbara, under the National Science Foundation Grant No. SES 0531184. Scholars and other people using this interview should acknowledge in all written publications. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the interviewee and interviewer and do not necessarily reflect the views of the National Science Foundation.

This oral history series is an important resource for the history of nanotechnology, documenting the lives and career of key scientists and engineers that shaped and contributed to the contemporary practice of science and technology.

THE CHEMICAL HERITAGE FOUNDATION  
Oral History Program  
Release Form

The Oral History Program of the Chemical Heritage Foundation (CHF) aims to preserve the history of science, medicine, and technology through the recollections of those who have contributed to the advancement, dissemination, and use of scientific knowledge, practices, and technologies. Our mission is to ensure that current and future generations of scholars, researchers, and interested individuals are able to understand the life of a scientist and the scientific life—an interviewee's childhood interests, educational experiences, laboratory practices, and the successes, disappointments, triumphs, and failures of a career in science—from the perspectives of the women and men intimately involved in new discoveries and innovations, as recorded in their own words.

I agree to be interviewed by David C. Brock, representing the Chemical Heritage Foundation (CHF), on January 24, 2011. I understand that my oral history interview will be made part of CHF's collections and will be available for educational, non-commercial use. I also understand that this document is intended to inform me fully of what I am being asked to do and my rights as an interviewee.

#### The Oral History Interview

This interview will be recorded within the period of time previously agreed upon by me and David C. Brock. Should David C. Brock feel that more time is needed to complete the interview, arrangements can be made to extend the interview at my convenience. Once my interview is complete, it will be transcribed and edited for readability in accordance with the Oral History Program's policies and procedures. I will be given an opportunity to make changes to my interview before the final transcript is completed. No one outside of the Oral History Program, its affiliates, and David C. Brock will be able to access my interview until the final transcript is finished.

#### My Rights

I understand that I have the right not to answer any of the questions asked of me during the interview should I consider them uncomfortable or inappropriate. If I need to take a break from the interview or if I have a question or point for clarification during the interview, I can ask that the recorder be turned off temporarily. My participation in this interview is completely voluntary and I am free to withdraw consent and cease all participation in this oral history at any time without any penalty whatsoever.

#### Risks, Benefits, and Costs

There are no known risks or discomforts associated with participation in this interview, and I may not receive any direct benefit from my participation, but I am fully aware that others may benefit from the knowledge I provide in this interview for CHF's oral history collection. I understand that there is no cost to participate in this interview and I will not be paid for my time; I will, however, receive a professionally-bound copy of my interview.

#### My Obligations

Once the Oral History Program has sent me a copy of my oral history transcript, I agree that (a) I will return the transcript with my edits to CHF within three months of its receipt by me and that (b) should I not return the edited transcript within that time, I agree that CHF may complete the

THE CHEMICAL HERITAGE FOUNDATION  
Oral History Program  
Release Form

processing of the transcript and make it available in accordance with the Foundation's normal practices. I also agree that if I should die or become incapacitated before I have reviewed and returned the transcript, all right, title, and interest in the recordings, transcript, photographs, and memorabilia, including the literary rights and copyright, shall be transferred to the Chemical Heritage Foundation, which pledges to maintain the recording and transcript and make them available in accordance with general policies for research and other scholarly purposes.

CHF's Joint Project with the Center for Nanotechnology in Society (CNS), University of California, Santa Barbara, under the National Science Foundation  
Grant No. SES 0531184

As a participant in this joint project between CHF and CNS, I agree that the recordings, transcripts, photographs, research materials, and memorabilia will be maintained by the Chemical Heritage Foundation and made available in accordance with general policies for research and other scholarly purposes. Upon completion of the final transcript, I hereby grant, assign, and transfer to the Chemical Heritage Foundation all right, title, and interest in the oral history, including the literary rights and the copyright, except that I shall retain the right to copy, use, and publish it in part or in full until my death. The final transcript will be made available for use and for download on CHF's and CNS's websites, respectively.

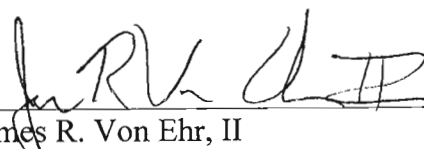
Questions or Concerns

Should I have any questions or concerns about participating in the creation of this oral history before or during the recording of the interview or about the processing of the transcript, I can contact the Program Manager for Oral History at the Chemical Heritage Foundation:

David J. Caruso, PhD  
Program Manager, Oral History  
The Chemical Heritage Foundation  
315 Chestnut Street  
Philadelphia, PA 19106  
[dcaruso@chemheritage.org](mailto:dcaruso@chemheritage.org)  
(215) 873-8236

Agreement

I have read the information contained within this release form, and David C. Brock has offered to answer any questions or concerns I had about this document or the interview. I hereby consent to participate in this oral history interview.

(Signature)   
James R. Von Ehr, II  
(Date) JAN 24 2011

This oral history is designated **Free Access**.

**Please note:** Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation (CHF) Oral History Program to credit CHF using the format below:

James R. Von Ehr, II, interview by David C. Brock at Zyvex Labs, Inc, Richardson, Texas, 24 January 2011 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0685).



Chemical Heritage Foundation  
Oral History Program  
315 Chestnut Street  
Philadelphia, Pennsylvania 19106



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.

## **JAMES R. VON EHR, II**

1950 Born in Grand Rapids, Michigan, on 2 June

### Education

1972 B.S., Computer Science, Michigan State University  
1982 M.S., Mathematical Sciences (Computer Science), University of  
Texas, Dallas

### Professional Experience

1973-1984 Texas Instruments  
Section Manager, Senior Member of Technical Staff

1984-1995 Altsys Corp.  
Founder, President & CEO

1995-present Zyvex Group  
Founder and CEO

## ABSTRACT

**James R. Von Ehr, II**, grew up in Grand Rapids and New Buffalo, Michigan, one of three children. His parents did not attend college but emphasized that education was important. Von Ehr's interest in electronics was fostered by the gift of some vacuum tubes, a homemade Heathkit ham radio, and electronics magazines. He was a page in the Michigan legislature when he was fourteen, and he finished high school as one of the first two National Merit Scholars from New Buffalo. This achievement won him a scholarship to Michigan State University, where he began a physics major but switched to computer science. He and some others, wanting to see how the operating system worked, hacked into MSU's computer system; this breach was traced to him, and he was forced to desist, but the group thought of themselves as the "alternative systems programming group," a name Von Ehr memorialized in the name of his first company, "Altsys Corporation."

Von Ehr's first job was developing CAD tools for integrated circuit layout for Texas Instruments (TI). On his first day there he met his future wife, Gayla, who was also an engineer. While at TI he obtained a master's degree at the University of Texas at Dallas. Disagreement with the goals of management caused Von Ehr to leave TI and, with Kevin Crowder, to start his first company, Altsys Corporation. They began with a plan to develop games, running the entire operation from Von Ehr's house. Eventually they decided on utilities for Macintosh computers, which he says, wistfully, had beautiful architecture. Settling on font editing, they developed FONTastic, helping create desktop publishing. Next was FONTographer for Apple's LaserWriter, used to develop typefaces for most of the world's languages. Business was so good they expanded out of the house into a real office. Next Von Ehr developed FreeHand, which he licensed to Aldus Corporation. Eventually he got FreeHand back and sold Altsys to Macromedia, where he continued working for two years. He hired the team that wrote Dreamweaver; eventually Adobe took over the business and killed FreeHand. Von Ehr had been selling his stock gradually, and at that point he started a new company, Zyvex Corporation.

Von Ehr had become fascinated by nanotechnology as a result of hearing Eric Drexler speak and of reading his books. He has funded Zyvex's foray into nano with a great deal of his own money because he believes in nano. Von Ehr had expected rapid development along the lines of computer technology, but he says that the United States is behind China and Japan in commercialization.

Zyvex received grants from the National Institute of Standards and Technology (NIST) and the Defense Advanced Research Projects Agency (DARPA). Early on they partnered with Honeywell for a grant from the Advanced Technology Program (ATP), one of the few government programs Von Ehr considers worthwhile. When ATP was shut down Von Ehr fired his President/COO and assumed management himself. The company was split into three companies, one of which was sold. Von Ehr sees nano becoming increasingly important in medicine—Zyvex is involved in a joint venture—Nano-Retina—with an Israeli company to develop a vision system for the blind—and in military applications, as well as in quantum computing. He and Steven Jurvetsen attended the signing of the 21<sup>st</sup> Century Nanotech Research and Development Act, sponsored by Senator George Allen, where he felt impressed by the White House and exhilarated by standing next to President Bush.

With E. Glenn Gaustad Von Ehr formed the Texas Nanotechnology Initiative. He has also endowed scholarships at Michigan State University; he describes the process of application for one of the scholarships, saying he thinks he could never have won one. He continues to work at Zyvex Labs and his Singapore company, Zycraft. He is fascinated by energy, especially energy storage, and would like to establish an energy storage company; but he says that the government regulations and mandates make a new company prohibitively expensive and even threaten personal freedom. He says he would establish a public company only outside the United States.

Von Ehr meditates on the interface between computers and nano; the inevitability of progress; the value of competition. He thinks the government's role should be to encourage invention by purchasing new technology, such as LED lighting, when it is at its most expensive; let entrepreneurs, not research at universities, develop new products. We should use the example of the semiconductor revolution: let private enterprise invent and develop by incremental goals. He wishes the NNI would focus on energy and energy storage; as an example of poor planning he points to the windmills in Texas, which are underutilized because there is no way to store their energy, nor to transport it to market. He believes nature makes the best catalysts; we should learn from the ways biological mechanisms work and emulate nature's atomic precision.

In addition to his work, Von Ehr finds enjoyment in reading science fiction, in his art collection (he loves Escher's unique way of looking at things), music, and promoting his libertarian ideals, including through the Cato Institute, Reason Foundation, and the Competitive Enterprise Institute, where he is now on the Board of Directors. He explains that he discontinued his subscription to *Scientific American* because it became a forum for personal attacks on scientists who did not toe George Soros's left-liberal party line. He talks a little about transhumanism and artificial intelligence and the ability of humans to adapt. He continues to believe in nano and is convinced that history will vindicate him.

## INTERVIEWER

**David C. Brock** is a senior research fellow with the Center for Contemporary History and Policy at the Chemical Heritage Foundation. As a historian of science and technology, he specializes in the history of semiconductor science, technology, and industry; the history of instrumentation; and oral history. Brock has studied the philosophy, sociology, and history of science at Brown University, the University of Edinburgh, and Princeton University.

In the policy arena Brock recently published *Patterning the World: The Rise of Chemically Amplified Photoresists*, a white-paper case study for the Center's Studies in Materials Innovation. With Hyungsub Choi he is preparing an analysis of semiconductor technology roadmapping, having presented preliminary results at the 2009 meeting of the Industry Studies Association.



## TABLE OF CONTENTS

Early Years and College	1
<p>Born in Grand Rapids, Michigan. Family background. Moving to Kalamazoo, back to Grand Rapids, and then to New Buffalo. Ham radio, vacuum tubes, electronics magazines. Page in Michigan legislature. National Merit Scholar. Enters Michigan State University with physics major, but switches to computer science. College job programming for hospital automation. Loved computers. Wanted to see how operating system worked; with friends hacked into MSU computer. Thought of selves at “alternative systems programming group;” hence name for later company, “Altsys”.</p>	
First Job	17
<p>Finished school with no job offer. Saw that Texas Instruments (TI) was hiring; drove camper to Texas, had girlfriend cut hair, applied for job, hired on the spot. Systems programmer developing CAD tools for design of design integrated circuits. Met future wife, also an engineer, his first day on job. Worked on operating system, lots of architecture. Apollo workstation. Wife’s programming work. Became section manager. Obtained master’s degree at University of Texas at Dallas. Problems with management. Wrote two computer games, but TI dropped home computer, so Von Ehr left to form own company.</p>	
Altsys Corporation	29
<p>Kevin Crowder, cofounder. Used Apple computer and synthesizer with his own music. Games until market crashed in December of 1983. Then used Compaq computers to write text editor for IBM pc’s. Windows came out, so he switched to utilities for Macintosh, which had beautiful architecture. Font editor, typeface design. Had to learn C programming language, typefaces, Mac computers. Helped create desktop publishing. Developed FONTastic. Typefaces for Apple’s LaserWriter. Developed FreeHand, licensed to Aldus Corporation. Got back FreeHand, sold company to Macromedia. Aldus bought by Adobe. <i>Forbes Magazine</i>. Libertarianism. Helped Macromedia with transition for two years. Wrote Dreamweaver. Macromedia invented Flash; company bought by Adobe Systems, Inc.</p>	
Zyvex Corporation	52
<p>Talk and books by Eric Drexler introduced him to nanotechnology (nano). Foresight Institute. Lack of vision for nano, so started own company, Zyvex. Objections to nanotechnology; conflict led to National Nanotechnology Initiative (NNI). George Soros and John Rennie against opportunity, technology, and profit; character assassination of their opponents, Bjørn Lomborg and Drexler, caused Von Ehr to cancel his subscription to <i>Scientific American</i>. Ralph Merkle. Expected faster development because of speed of computer technology development. Wilson Ho’s experiment, using scanning tunneling microscope (STM). Setting up company. First COO did much harm and good.</p>	

Depassivation. Ultra high vacuum (UHV). Nanotubes and buckyballs. Rodney Ruoff used first nanomanipulator inside electron microscope. Intel, persuaded by chief scientist, Richard Stallcup, first customer. Wanted to commercialize, but customers initially only wanted to rent. Sold nanomanipulator company to DCG Systems, Inc.

#### Middle Years at Zyvex

80

Applicability of models. Robert Freitas, *Nanomedicine*; Ralph Merkle on metabolism. Grants for probe system from National Institute of Standards and Technology (NIST) and Defense Advanced Research Projects Agency (DARPA). Partnered with Honeywell International for large five-year grant from NIST's Advanced Technology Program (ATP). Silicon micromachines. Engineer Rahul Saini. Developing Nano-Retina with Rainbow Medical. Shutdown of ATP. John Randall. Thomas Kenny. Fired COO, took over himself. STARTech board. Restructured company into three companies: tools, materials, and labs; sold the tools company. Materials company based in Columbus, Ohio. Jian Chen, first nanotube chemist. Functionalized tubes, patent near-miss. Investors include Lockheed, Arkema. Boat prototype made of prepreg. Robotic control for military applications. Some sporting goods. Quantum computing. Michelle Simmons's lab in Australia. Joseph Lyding and epitaxy. UHV feasible, but cryogenic temperatures not. Steven Jurvetsen and signing 21<sup>st</sup> Century Nanotech Research and Development Act, sponsored by Senator George Allen. Visit to White House, standing next to President Bush.

#### Thoughts and Pleasures

110

NNI should focus on energy, especially energy storage. Thinks entrepreneurs should work on nano; government should lead way by consuming early, costly products. Competition is good. We should learn from ways biological mechanisms work. We should emulate nature's atomically precise size. Feels he has enough money to do what he wants. History will validate his ideas. Sarbanes-Oxley imposes prohibitive costs on going public; he would never risk his own net worth and freedom. Might establish public company outside United States. Cato Institute. Michael Crichton's *Prey* and other science fiction. His art collection; especially likes M.C. Escher. Likes music. Interest in energy conversion. Thinks nature is best catalyst. No grid storage for windmills so much of Texas's wind power turned off. Fascinated by VRB Power in Canada, bought by Chinese; wishes he'd bought.

#### Current and Future State of Nano

120

Universities good only for producing graduates, many foreign; United States poses visa problems. We should use example of semiconductor revolution: look to industry and have incremental goals. Japan's investment in glass companies and tires. Toxicity tests on nanotubes show no inhalation; good substitute for carbon black. Barriers to entry by EPA, OSHA, other agencies. China and Japan ready to market. China working on anti-counterfeit printing

that uses no ink; research facility in Beijing now closed to tourists, so probably making progress. View of EPA: “facts don’t necessarily lead to regulation.” Tubes embargoed going to China; products designed and sold here but made there. Growth of technology. Ray Kurzweil. Transhumanism, artificial intelligence. Ability of humans to adapt. Mihail Roco and NNI. Senatorial Trust; attending President Bush’s second inauguration. Von Ehr’s libertarian ideals. Against price supports but thought ATP a good program. With E. Glenn Gaustad formed Texas Nanotechnology Initiative. Endowed scholarships at Michigan State University. Future of molecular nanotechnology. Python, C++. Computer hackery, not computer science. Lego Mindstorms. Interface between computers and nanotechnology. Power of assembly. Continuing invention. Medicine. Inevitability of progress.

## INDEX

### 2

21<sup>st</sup> Century Nanotech Research and  
Development Act, 109

### A

Adobe Systems, Inc., 40, 43, 44, 46, 48, 49,  
57, 58, 62

Illustrator, 46, 62

Akron, Ohio, 98

Aldus Corporation, 44, 46, 48, 49, 62

PageMaker, 44, 46

Allen, Senator George F., 111

Altsys Corporation, 34, 46, 48, 49, 56, 58,  
65, 123

FreeHand, 44, 46, 47, 48, 49, 62

American Cyanamid, 9

Apollo workstation, 20, 21, 24

Apple, Inc., 30, 31, 32, 34, 36, 38, 40, 41,  
44

Apple II, 30, 31, 32, 34, 36

LaserWriter, 40, 41

Macintosh, 35, 36, 37, 38, 39, 41, 42, 45,  
114

Applied Materials, 103

Arkema, 97, 129, 132, 134

artificial intelligence language, 27

Lisp, 26, 27

ASAP, 52

Asia, 100, 127

Atkinson, Bill, 37

ATP. *See* National Institute of Standards  
and Technology:Advanced Technology  
Program

Austin, Texas, 26, 89

Australia, 46, 101, 102

Authorware, Inc., 47

### B

Baney, Ed, 7

Baughman, Ray H., 140, 142

Bayer Group, 128, 132

Beagle Bros, 36

Berkeley Physics, 10

Berlow, David, 65

Bézier curves, 42

Biomedical Computer Services, Inc., 9

Black, Roger, 65

Boston, Massachusetts, 21, 41, 139

Brainerd, Paul, 44, 46

Brody, Neville, 65

buckyballs, 84, 96, 100, 116

Bucy, J. Fred, 23

Bush, President George W., 109, 112, 136,  
138

Bynum, Don, 23

### C

CAD. *See* computer-aided design

California, 21

Canada, 44, 125

Carbon Nanotechnologies, Inc., 133

Cato Institute, 121, 138

Cayman Islands, 122

*Chemical & Engineering News*, 108

Chen, Jian, 96

Chicago, Illinois, 2, 75

China, 71, 126, 130, 131, 132, 140, 141,  
142

Clarke, Arthur C., 110

Colorado, 17

Commodore (computer), 34

Compaq Computer Corporation, 33, 35, 39

computer-aided design, 35, 36, 45, 53, 54,  
61, 147, 148

Control Data Corporation, 12

Crane, Edward H., 138

Crichton, Michael, 122

Crowder, Kevin, 29, 34, 37, 38, 40, 61

### D

Dallas, Texas, 27, 52, 129, 139, 140, 143,  
147

DARPA. *See* Defense Advanced Research  
Projects Agency  
Dayton, Ohio, 97  
dBASE, 39  
DCG Systems, Inc., 86  
Defense Advanced Research Projects  
Agency, 90, 93, 94, 101, 137  
depassivation, 82, 93, 100, 101, 102, 104,  
106  
desktop publishing, 39, 44  
Detroit, Michigan, 6, 97, 99  
Diffie, B. Whitfield, 89  
DNA, 106, 107, 108  
Drexler, K. Eric, 52, 53, 60, 65, 68, 69, 78,  
79, 82, 90, 104, 108, 110, 115, 117, 120,  
136

## E

Emu Systems, 31  
*Engines of Creation*, 65, 117  
epitaxy, 102, 103, 104, 106  
Escher, M.C., 122, 123  
Europe, 94, 95, 126

## F

Fairchild Semiconductor, 76  
Feynman, Richard P., 56, 60, 61  
Flemming, Mike, 3  
FONTastic, 40  
Fontographer, 42, 44, 45  
*Forbes Magazine*, 52, 68  
Forbes, Malcolm S., 52  
Foresight Institute, 63, 65, 66, 67, 69, 108  
Freitas, Robert A., 88, 89, 108  
fullerenes, 96, 100

## G

Garland, Texas, 17  
Gaustad, E. Glenn, 140  
Georgia, 44  
Germany, 2  
Gillis, S. Malcolm, 140  
Gou, Terry, 131  
Grand Rapids, Michigan, 1, 2, 3

Great Plains Software, 38

## H

Halls, Mat, 124  
Halperin, James L., 120  
Hanne, John, 26, 50  
Harvard University, 107  
Hayek, Friedrich, 52  
Heard, David, 97  
Hellman, Martin E., 89  
Heritage Auction Galleries, 120  
Herszberg, Wolfe, 46  
Hertzfeld, Andy, 37, 42  
Hewlett Packard Company, 85  
High-Efficiency Particulate Air filters, 129  
Hindi, 41  
Ho, Wilson, 74, 75, 118  
Holland, 146  
Honeywell International, 91, 92, 140  
Hong Kong, 143  
Houston, Texas, 26, 28  
Hulse, Russell A., 147  
hypertext markup language, 146

## I

IBM. *See* International Business Machines  
IEEE. *See* Institute of Electrical and  
Electronics Engineers  
India, 41  
Institute of Electrical and Electronics  
Engineers, 60, 67  
integrated circuit, 18, 19, 22, 23, 31, 55, 70,  
71, 73, 76, 78, 85, 127, 148, 149, 150  
Intel Corporation, 34, 36, 37, 85, 86  
International Business Machines, 13, 20, 33,  
35, 75, 76  
personal computer, 33, 35

## J

Japan, 47, 126, 127, 129, 130  
Jurvetsen, Steven T., 109

## K

Kalamazoo, Michigan, 2, 16

Kane Qubit, 106  
Keithley Instruments, 86  
Kenny, Thomas W., 93  
Kentera, 133  
Kilby, Jack S., 70, 73, 76  
Kurzweil, Raymond, 67, 68, 135

## L

Lansing, Michigan, 5, 6, 10  
Lego Mindstorms, 147  
Letraset, 46  
libertarian, 52, 67, 91, 121, 137, 138, 143  
Liu, Haiying, 96  
Lockheed Martin Corporation, 97  
Lomborg, Bjørn, 68  
Lubbock, Texas, 29  
Lyding, Joseph W., 102, 145

## M

MacDiarmid, Alan G., 140  
Macromedia, 47, 48, 49, 56, 57, 58, 62, 64, 90, 91  
    Dreamweaver, 57  
    Flash, 47, 57  
MacroMind-Paracomp, 47  
*Macworld*, 38  
Massachusetts Institute of Technology, 8, 27, 131  
MEMS. *See* microelectromechanical system  
Merkle, Ralph C., 69, 71, 88, 89, 93, 108, 117, 122, 135  
Metroplex Technology Business Council, 25  
Michigan, 17  
Michigan State University, 9, 10, 11, 14, 15, 142  
microelectromechanical system, 80, 81, 92, 119, 149  
Microsoft Corporation, 33, 35, 54  
    Windows, 35  
Minneapolis, Minnesota, 10  
MIT. *See* Massachusetts Institute of Technology  
Molecular Electronics Corporation, 101  
Moore, Charles H., 43

Moore, Gordon E., 135  
Moore's Law, 79, 135  
Motorola, Inc., 37  
Musk, Elon, 59

## N

nano imprint lithography, 71, 130  
nanomanipulator, 84, 85, 90, 92  
*Nanomedicine, Volume I*, 89  
Nano-Retina, 92, 100, 119  
*Nanosystems*, 60  
nanotechnology, 50, 52, 53, 55, 59, 60, 61, 64, 66, 67, 68, 69, 70, 71, 72, 74, 75, 77, 79, 90, 96, 98, 104, 109, 111, 112, 114, 115, 117, 118, 119, 120, 122, 123, 124, 125, 126, 130, 131, 135, 138, 139, 143, 145, 146, 150, 152  
nanotube, 84, 85, 96, 98, 99, 116, 127, 128, 129, 130, 131, 132, 133, 134  
NASA. *See* National Aeronautics and Space Administration  
National Aeronautics and Space Administration, 4, 107, 114  
National Institute of Standards and Technology, 90, 91, 92, 93, 94, 138, 139, 149  
    Advanced Technology Program, 91, 92, 93, 94, 138, 139, 149  
National Merit Scholarship, 9  
National Nanotechnology Initiative, 67, 85, 112, 126, 127, 135, 136  
National Science Foundation, 110, 138  
National Security Agency, 101  
*Nature*, 69  
New Buffalo, Michigan, 2, 3  
New Zealand, 140  
NIST. *See* National Institute of Standards and Technology  
NNI. *See* National Nanotechnology Initiative  
Nobel Prize, 110, 111, 140, 141, 142, 144, 147  
North Texas Nanotech Initiative, 140  
NSF. *See* National Science Foundation

## O

Occupational Health and Safety  
Administration, 129  
Ohio, 96, 97  
Owen, James, 126

## P

Palo Alto Research Center, 89  
Palo Alto, California, 57  
PARC. *See* Palo Alto Research Center  
patents, 96, 124, 132  
Paynter, Herb, 44  
Pearl Harbor, Hawaii, 1  
Peck, Paul, 25  
Poplar, Lou, 15  
*Prey*, 122  
programming languages  
Adobe Systems, Inc. PostScript, 40, 41,  
42, 43, 44, 45  
C, 38, 89, 150  
C++, 146  
Forth, 43  
FORTRAN, 11, 13, 18, 19, 21  
Java, 57  
Pascal, 21, 38  
Python, 146  
Prudent Energy, 125

## Q

quantum computer, 101, 104, 106  
Quark, Inc., 44  
QuarkXPress, 44

## R

Rainbow Medical, 92  
Randall, John, 17, 81, 82, 93  
Rennie, John, 67, 68, 69  
Rice University, 101, 113, 140  
Richardson, Texas, 25  
Rivest, Ronald L., 89  
Roberts, Martin, 24  
Roco, Mihail C., 126, 135, 136  
Romney, Governor George W., 6  
Rossum, Guido van, 146

Rossum, Just van, 146  
Ruoff, Rodney S., 84, 85

## S

Saini, Rahul, 92, 100  
San Francisco, California, 57  
Sarbanes-Oxley Act, 119  
scanning tunneling microscope, 71, 74, 75,  
80, 103  
Schumpeter, Joseph, 52  
*Scientific American*, 60, 66, 68  
Seals-Mason, Samantha, 56  
Seattle, Washington, 46  
Shepherd, Mark, 23  
Simmons, Michelle Y., 101, 102  
Singapore, 102, 126, 143  
*Skeptical Environmentalist*, 68, 69  
Smalley, Richard E., 69, 76, 108, 110, 111,  
112, 116, 133, 140  
Smith, Bill, 30  
Solomon, Mike, 48  
Soros, George, 67, 68  
SpaceX (Space Exploration Technologies  
Corporation), 59  
Stallcup, Richard, 85, 90  
Stanford Research Institute, 78  
Stanford University, 8, 93  
STARTech, 95  
STM. *See* scanning tunneling microscope  
Sun Microsystems, 21

## T

Taiwan, 131, 148  
Tennessee, 44  
Tesla car, 59  
Texas, 17, 18, 25, 57, 94, 125, 139, 142  
Texas Instruments, 17, 18, 19, 20, 22, 23,  
24, 25, 26, 27, 29, 30, 33, 34, 36, 37, 38,  
39, 42, 43, 45, 50, 51, 61, 76, 140, 150  
Texas Instruments Foundation, 60  
Kilby Young Innovators Award, 60  
Texas Nanotech Initiative, 140  
Tour, James M., 101  
transhumanism, 67  
Tsinghua University, 131

Tsinghua-Foxconn Nanotechnology  
Research Center, 131

## U

U.S. *See* United States of America  
U.S. Air Force, 97  
U.S. Department of State, 132  
U.S. Environmental Protection Agency,  
129, 132  
U.S. Navy, 1  
U.S. Senate, 111, 138  
UHV. *See* ultra high vacuum  
ultra high vacuum, 74, 80, 83, 104, 105,  
116, 118  
*Unbounding the Future*, 65  
United States of America, 46, 47, 67, 112,  
119, 120, 126, 127, 129, 130, 140, 142  
University of California, Irvine, 74  
University of Chicago, 75  
University of Illinois, 102  
University of Michigan, 9  
University of Texas, 26, 27, 52, 129, 139,  
140, 143, 147  
Upton, the Honorable Frederick S. "Fred", 6

## V

vanadium, 125  
Vermont, 148  
Vietnam War, 6, 15  
Von Ehr, Gayla (wife), 18  
Von Ehr, James R. (father), 1  
Von Ehr, Kevin (brother), 1

Von Ehr, Norma (mother), 1  
Von Ehr, Suzan (sister), 1  
Voss, Reg, 4  
VRB Power, 125

## W

Walker, John, 53  
*Wall Street Journal*, 52  
Waller, Fred, 7  
Warnock, John E., 62  
Washington, D.C., 6, 67, 138, 144  
Weiner, Leonard H., 12  
Welch Foundation, 142  
Willson, Grant, 76  
Wozniak, Stephen G., 31  
Wyoming, 63

## X

Xerox Corporation, 41, 89

## Y

Yu, Min-Feng, 84

## Z

Zyvex Asia, 100  
Zyvex Labs, 17, 58, 61, 64, 65, 74, 76, 83,  
88, 91, 94, 100, 106, 108, 111, 118, 119,  
120, 122, 123, 127, 139, 140, 145  
Zyvex Performance Materials, 100, 128,  
129