CHEMICAL HERITAGE FOUNDATION

SUSAN J. BIRREN

The Pew Scholars Program in the Biomedical Sciences

Transcript of an Interview Conducted by

William Van Benschoten

at

Brandeis University Waltham, Massachusetts

on

2, 3, and 4 August 2004

From the Original Collection of the University of California, Los Angeles

ACKNOWLEDGEMENT

This oral history is part of a series supported by a grant from the Pew Charitable Trusts based on the Pew Scholars Program in the Biomedical Sciences. This collection is an important resource for the history of biomedicine, recording the life and careers of young, distinguished biomedical scientists and of Pew Biomedical Scholar Advisory Committee members.

This oral history was completed under the auspices of the Oral History Project, University of California, Los Angeles (Copyright © 2006, The Regents of the University of California) and is made possible through the generosity of



From the original collection at the Center for Oral History Research, UCLA Library, UCLA.

The following oral history, originally processed at the UCLA Center for Oral History Research, has been reformatted by the Chemical Heritage Foundation. The process involved reformatting the front matter, adding a new abstract, replacing the table of contents, and replacing the index. The paragraph spacing and font of the body of the transcript were altered to conform to the standards of the Oral History Program at the Chemical Heritage Foundation. The text of the oral history remains unaltered; any inadvertent spelling or factual errors in the original manuscript have not been modified. The reformatted version and digital copies of the interview recordings are housed at the Othmer Library, Chemical Heritage Foundation. The original version and research materials remain at the Darling Library, University of California, Los Angeles and at the Bancroft Library, University of California, Berkeley.

REFORMATTING:

Kim Phan, Program Intern, Oral History, Chemical Heritage Foundation. B.A. expected 2011, Anthropology, Cornell University.

David J. Caruso, Program Manager, Oral History, Chemical Heritage Foundation. B.A., History of Science, Medicine, and Technology, Johns Hopkins University; PhD., Science and Technology Studies, Cornell University. I, Susan J. Birren, do hereby give to the Regents of the University of California the series of interviews the UCLA Oral History Program recorded with me beginning on or about August 2, 2004, to be used for any research, educational, or other purpose that the University may deem appropriate. I give these as an unrestricted gift and I transfer to the Regents of the University of California all rights, including the copyright. I understand that I may still use the information in the recordings myself without seeking permission from the University.

I have read the UCLA Oral History Program Use Policy, which outlines the current and likely future uses of interviews donated to the Oral History Program's collection.

Unless otherwise specified below, I place no restrictions on access to and use of the interviews.

(Signature)

Susan J. Birren (Typed Name)

Department of Biology, M/S 008, Brandeis University, 415 South Street Waltham, Massachusetts 02454 (Address)

781.736.2680 (Phone Number) barren@brandeis.edu (E-mail Address)

 $\frac{3/2}{(\text{Date})}$

The Regents of the University of California hereby acknowledge this deed of gift

*luin*u <u>B</u>unne

(Director, UCLA Oral History Program)

This interview has been designated as Free Access.

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

Susan J. Birren, interview by William Van Benschoten at Brandeis University, Waltham, Massachusetts, 2-4 August 2004 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0459).



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.

SUSAN J. BIRREN

1958	Born on 24 November, in Freeport, New York
	Education
1980 1987	A.B. with distinction, Biochemistry, University of California, Berkeley Ph.D., Biological Chemistry, University of California, Los Angeles
	Professional Experience
1987-1993	California Institute of Technology Postdoctoral Fellow
1997-1998	Marine Biological Laboratories, Woods Hole, Massachusetts Instructor, Summer Neurobiology Course
2002-2005	Society for Neuroscience Committee for Women in Neuroscience
2002	The Medical Foundation, Scientific Advisory Committee
2004	National Institute of Heart, Lung, and Blood Ad-Hoc Reviewer
Present	Volen National Center for Complex Systems Member
Present	Brandeis University, Waltham, Massachusetts Associate Professor, Department of Biology
Honors	
1982-1986 1986-1987	USPHS/NRSA Predoctoral Trainee Associated Western Universities Laboratory Research Award, California Institute of Technology
1987-1990	Damon Runyon-Walter Winchell Cancer Research Fund post-doctoral Fellowship, Brandeis University
1994	American Heart Association, Massachusetts Affiliate, Beginning-Grant-
1996	Whitehall Foundation Research Award

- 1996 Pew Scholars Award
- 2000 Alberta Gotthardt and Henry Strage Award for Aspiring Young Science Faculty

Selected Publications

- Butler-Gralla, E., Taplitz, S.J., and Herschman, H.R. 1983. 12-OTetradecanoylphorbol- 13 Acetate stimulates release of arachidonic acid, prostaglandin E2 and prostaglandin F2a from TPA non-proliferative variants of 3T3 cells. Biochem. Biophys. Res. Commun. 111:194-199.
- Andersen, R.D., Birren, B.W., Taplitz, S.J., and Herschman, H.R. 1986. The rat metallothionein-I structural gene and three pseudogenes, one of which contains 5' regulatory sequences. Mol. Cell Biol. 6:302-314.
- Taplitz, S.J., Calame, K.L., and Herschman, H.R. 1986. Alternative inducers of the rat metallothionein I gene cause distinct changes in chromatin structure in the 5' region of the gene. Mol. Cell Biol. 6:2576-2581.
- Andersen, R.D., Taplitz, S., Birren, B., Bristol, G., and Herschman, H. 1986."Rat Metallothionein Multigene Family." in <u>Proceeding of the Second International Meeting on</u> <u>Metallothionein and Other Low Molecular Weight Metal Binding-Proteins.</u> (E. J.H.R. Kagi). Birkhauser Verlag, Basel.
- Andersen, R.D., Taplitz, S.J., Wong, S., Bristol, G., Larkin, B., and Herschman, H.R. 1987. Footprinting *in vivo* detects metal ion-dependent transcription factor binding at the metal responsive elements of the rat metallothionein-I gene. Mol. Cell Biol. 7:3574-2581.
- Birren, B.W., Taplitz, S.J., and Herschman, H.R. 1987. Butyrate-induced changes in nuclease sensitivity of chromatin cannot be correlated with transcriptional activation. Mol. Cell Biol. 7:3863-3870.
- Birren, S.J., and Anderson, D.J. 1990. A v-*myc* -immortalized sympathoadrenal progenitor cell line in which neuronal differentiation is initiated by FGF but not NGF. Neuron 4:189-201.
- Johnson, J.E., Birren, S.J., and Anderson, D.J. 1990. Two rat homologues of *Drosophila* achaete-scute are specifically expressed in neuronal precursors. Nature 346:858-861.
- Mori, N., Birren, S.J., Stein, R., Stemple, D., Vandenbergh, D.J., Wuenschell, C.W., and Anderson, D.J. 1990. Contributions of cell-extrinsic and cell-intrinsic factors to the differentiation of a neural-crest-derived neuroendocrine progenitor cell. Cold Spring Harbor Symposia on Quantitative Biol. 55:255-264.
- Andersen, R.D., Taplitz, S.J., Oberbauer, A.M., Calame, K.L., and Herschman, H.R. 1990. Metal-dependent binding of a nuclear factor to the rat metallothioneinI promoter. Nuc. Acid Res. 18:6049-6055.
- Lo, L.-C., Birren, S.J., and Anderson, D.J. 1991. V-myc immortalization of early rat neural crest cells yields a clonal cell line which generates both glial and adrenergic properties. Dev. Biol. 145:139-153.
- Johnson, J.E., Birren, S.J., Saito, T., and Anderson, D.J. 1992. DNA binding and transcriptional regulatory activity of mammalian achaete-scute homologous (MASH) proteins revealed by interaction with a muscle-specific enhancer. Proc. Natl. Acad. Sci. 89:3596-3600.
- Ip, N.Y., Nye, S.H., Boulton, Davis, S., Taga, T., Li, T., Birren, S.J., Yasukawa, K., Kishimoto,

T., Anderson, D.J., Stahl, N., and Yancopoulos, G.D. 1992. CNTF and LIF act on neuronal cells via shared signalling pathways that involve the IL-6 signal transducing receptor component gp130. Cell 69:1121-1132.

- Birren, S.J., Verdi, J.M., and Anderson, D.J. 1992. Membrane depolarization induces p140trk and NGF-responsiveness, but not p75LNGFR, in MAH cells. Science 257:395-397.
- Birren, S.J., Lo, L.-C., and Anderson, D.J. 1993. Sympathetic neuroblasts undergo a developmental switch in trophic dependence. Development 119:597-610.
- Verdi, J.M., Birren, S.J., Ibanez, C.F., Persson, H., Kaplan, D.R., Bennedetti, M.,
- Chao, M.V., and Anderson, D.J. 1994. p75^{NGFR} regulates trk signal transduction and NGFinduced neuronal differentiation in MAH cells. Neuron 12: 1-20.
- Ip, N.Y., Boulton, T.G., Li, Y., Verdi, J.M., Birren, S.J., Anderson, D.J., and Yancopoulos, G.D. 1994. CNTF, FGF and NGF collaborate to drive the terminal differentiation of MAH cells into post-mitotic neurons. Neuron 13:443-455.
- Verdi, J.M., Birren, S.J., Kaplan, D.R., and Anderson, D.J. 1995. The regulation and function of NGF receptors in normal and immortalized sympathoadrenal progenitor cells. in <u>Life and</u> <u>Death in the Nervous System.</u> pp155-180. (Eds. Ibañez, C., Hofkfelt, T., Olsen, L., Fuxe, K., Jornvall, H, and Ottoson, D.) Elsevier Science Inc.
- Birren, S.J., Verdi, J.M., and Anderson, D.J. 1995. Neuronal development in the rat sympathoadrenal lineage. in <u>Neural Cell Specification: Molecular Mechanisms and</u> <u>Neurotherapeutic Implications.</u> (Eds. Juurlink, B., Kulyk, W., Krone, V., Verge, V., and Doucette, R.) Plenum Press.
- Birren, S.J. 1995. MAH cells and the development of rat sympathetic neurons. Methods 7:268-276.
- Birren, S.J. and Anderson, D.J. 1997. Neuronal development in an immortalized sympathoadrenal cell line. in <u>Handbook of Experimental Immunology</u>. 5th Edition. (Eds. Herzenberg, L.A., Herzenberg, L.A., Weir, D.M., and Blackwell, C.) Blackwell Science. Boston.
- Lockhart, S.T., Turrigiano, G.G., and Birren, S.J. 1997. Nerve growth factor modulates synaptic transmission between sympathetic neurons and cardiac myocytes. J. Neurosci. 17:9573-9582.
- Birren, S.J. 1999. Growth and neurotrophic factors in sympathetic neuron development. in <u>Neurotrophins and the Neural Crest.</u> (Ed. Seiber-Blum, M.) CRC Press.
- Birren, S.J. 1999. Developmental regulation of synapse formation by neurotrophins. ISN News 4:20-22.
- Pisano, J.M. and Birren, S.J. 1999. Restriction of developmental potential during divergence of the enteric and sympathetic neuronal lineages. Development. 126:2855-2868.
- Lockhart, S.T., Mead, J.N., Pisano, J.M., Slonimsky, J.D., and Birren, S.J. 2000. Nerve growth factor collaborates with myocyte-derived factors to promote development of presynaptic sites in cultured sympathetic neurons. J. Neurobiol. 42:460-476.
- Worley, D.S., Pisano J.M., Choi, E.D., Walus, L., Hession, C.A., Cate, R.L., Sanicola, M., and Birren, S.J. 2000. Developmental regulation of GDNF response and receptor expression in the enteric nervous system. Development 127:43 83-4393.

Pisano, J.M., Colón, F., and Birren, S.J. 2000. Postmigratory enteric and sympathetic precursors share common, developmentally regulated, responses to BMP-2. Dev. Biol. 227:1-11.

Bharmal, S, Slonimsky, J.D., Mead, J.N., Sampson, C.P.B., Tolkovsky, A.M, Yang, B.,

Bargman, R., and Birren, S.J. 2001. Target interactions promote the functional maturation of neurons derived from a sympathetic precursor cell line. Dev. Neurosci. 23:153-164.

- Yang, B., Slonimsky, J.D., and Birren, S.J. 2002. A rapid switch in sympathetic neurotransmitter release properties mediated by the p75 receptor. Nature Neuroscience 5:539-545.
- Slonimsky, J.D., Yang, B., Hinterneder, J., E. Nokes and Birren, S.J. 2003. BDNF and CNTF mediate sympathetic neuron cholinergic differentiation via independent mechanisms. Mol. Cell. Neurosci. 23:648-660.
- Dore, J.J., Crotty, K.L. and Birren, S.J. 2005. Inhibition of glial maturation by bone morphogenetic protein-2 in a neural crest-derived cell line. Dev. Neurosci. 27:37-48.
- Lin, P.-Y., Hinterneder, J.M., and Birren, S.J. 2005. Regulation of basal forebrain neuron development by neurotrophins, neuronal activity, and the p75 receptor. *Submitted*.
- Slonimsky, J.D., Mattaliano, M.D., Moon, J., Griffith, L.C., and Birren, S.J. 2005 Role for calcium/calmodulin-dependent protein kinase II in the p75-mediated regulation of sympathetic cholinergic transmission. *Submitted*
- Luther, J.A., and Birren, S.J. Nerve growth factor alters neuronal firing properties and potassium currents in sympathetic neurons. 2005. *Submitted*.

ABSTRACT

Susan J. Birren spent time in New York and Washington, D.C., though grew up mostly in Kentfield, California, just north of San Francisco, the second youngest of four siblings. Her father was a lawyer, and then an administrative law judge, for the National Labor Relations Board; her mother studied art and worked as a designer in the garment industry until she had children, after which she became a professional artist. Her family did much together—camping, sailing, hiking, and general playing—and Birren was an avid reader and enjoyed exploring nature. Academics came easily and she had a clear interest in science and mathematics throughout her early schooling; a female chemistry teacher in high school, with a master's degree, proved somewhat influential.

Birren applied to two schools only for college and undertook her undergraduate career at the University of California, Berkeley. Initially interested in studying mathematics, she decided to switch to biochemistry for her major and had the opportunity to work with Edward E. Penhoet, who later became one of the founders of Chiron Corporation. She worked on isolating opsins from a halobacterium, a high-salt bacterium, but, more importantly, she fell in love with lab life and lab culture and benefitted from being mentored by Penhoet. From Berkeley she moved on to the University of California, Los Angeles working with Harvey R. Hirschman on the transcriptional regulation of the metallothionein gene; while there, Kathryn L. Calame also served as a mentor. Birren decided to remain in California for her postdoctoral work, moving into the lab of David J. Anderson at the California Institute of Technology, studying the differentiation of neural crest cells. From there she went on to a faculty position at Brandeis University looking at the functional development of neurons.

During the interview Birren was candid about being a working mother and dealing with a chronic medical condition. At the end of the interview she discusses gender issues in science; administrative duties; the grant-writing process; balancing career and family; the issue of patents; creativity in science; and the role of serendipity in her work. The interview concludes with thoughts on teaching the history of science; the process of conducting scientific research; setting the national scientific agenda; the role of the scientist in educating the public; and the role of the Pew Scholars Program in the Biomedical Sciences on her work.

UCLA INTERVIEW HISTORY

INTERVIEWER:

William Van Benschoten, Interviewer, UCLA Oral History Program. B.A., History, University of California, Riverside; M.A., History, University of California, Riverside; C. Phil., History, UCLA

TIME AND SETTING OF INTERVIEW:

Place: Birren's office, Brandeis University.

Dates, length of sessions: August 2, 2004; August 3, 2004; August 4, 2004

Total number of recorded hours: 6

Persons present during interview: Birren and Van Benschoten.

CONDUCT OF INTERVIEW:

This interview is one in a series with Pew Scholars in the Biomedical Sciences conducted by the UCLA Oral History Program in conjunction with the Pew Charitable Trusts's Pew Scholars in the Biomedical Sciences Oral History and Archives Project. The project has been designed to document the backgrounds, education, and research of biomedical scientists awarded four-year Pew scholarships since 1988.

To provide an overall framework for project interviews, the director of the UCLA Oral History Program and three UCLA faculty project consultants developed a topic outline. In preparing for this interview, Van Benschoten held a telephone preinterview conversation with Birren to obtain written background information (curriculum vitae, copies of published articles, etc.) and agree on an interviewing schedule. He also reviewed documentation in Birren's file at the Pew Scholars Program office in San Francisco, including Birren's proposal application, letters of recommendation, and reviews by Pew Scholars Program national advisory committee members.

ORIGINAL EDITING:

Carol Squires edited the interview. She checked the verbatim transcript of the interview against the original tape recordings, edited for punctuation, paragraphing, and spelling, and verified proper names. Words and phrases inserted by the editor have been bracketed.

Birren reviewed the transcript. She verified proper names and made a minor number of corrections and additions.

Carol Squires prepared the table of contents and TechniType Transcripts compiled the guide to proper names.

TABLE OF CONTENTS

Early Years

Family background. Birren' s parents and her siblings. Family experiences. Religion. Childhood interests and experiences. Early schooling. Attending junior high school and high school. Extracurricular activities. Influential teacher. Parental expectations

College Years

Attends the University of California, Berkeley. Decision to pursue science. First laboratory experience working for Edward E. Penhoet isolating opsins. Penhoet's mentoring style. Perspectives on Berkeley.

Graduate and Postdoctoral Years

Attends graduate school at the University of California, Los Angeles in Harvey R. Herschman's laboratory. Meets and marries her husband. Her postdoctoral fellowship in David J. Anderson's laboratory at the California Institute of Technology. Herschman's mentoring style. Her doctoral research in molecular biology on transcriptional regulation of the metallothionein gene. A typical day in graduate school. Mentoring by Kathryn L. Calame. The process of writing journal articles. Anderson's laboratory management style. Birren's postdoctoral research in neurobiology on the differentiation of neural crest cells. The birth of her children.

Faculty Years

Gender issues in science. Her husband's career. Accepts a position at Brandeis University. Setting up her laboratory. Collaborations. Current research in neurobiology on the functional development of neurons. Broader applications of her research. Funding history. The grant-writing process. Balancing family and career. What she likes most about being a Principal Investigator. Multiple sclerosis. A typical workday. Leisure activities.

Thoughts and Reflections

Professional and personal goals. Patents. Teaching the history of science. Tenure. Competition and collaboration in science. The process of conducting scientific research. Setting the national scientific agenda. Educating the public about science. Gender issues in science. Impact of the Pew Scholars Program in the Biomedical Sciences award on her work. Her mentoring style.

Index

96

33

1

41

68

123

INDEX

Abelson, John N., 56 acetylcholine, 79 American Heart Association, 80, 109 American Museum of Natural History, 22 Anderson, David J., 47, 50, 56, 57, 58, 59, 61, 62, 63, 64, 65, 67, 69, 70, 71, 72, 75, 85, 86, 87, 88 arachidonic acid, 48 autism, 81, 82, 109, 110

Α

B

Berkeley, California, 28, 37
Bethesda, Maryland, 6
Birren, Bruce, 7, 18, 19, 30, 42, 44, 45, 46, 47, 49, 50, 52, 56, 60, 61, 62, 64, 72, 73, 82, 88, 90, 93, 94, 95, 103
Birren, Natalie, 11, 18, 19, 22, 23, 28, 47, 60, 61, 62, 63, 69, 70, 88, 90, 93, 113
Birren, Peter, 11, 19, 61, 62, 70, 88, 90, 113
Boston, Massachusetts, 7, 12, 18, 72, 73
brain-derived neurotrophic factor, 79
Brandeis University, 5, 1, 34, 63, 69, 70, 73, 75, 78, 81, 83, 96, 99, 102, 104, 117, 120 *Breaking All the Rules*, 14

С

Calame, Kathryn L., 43, 53 California Institute of Technology, 46, 47, 55, 56, 67, 69, 71, 72 Cambridge, Massachusetts, 73 Cape Cod, Massachusetts, 16 cardiac myocytes, 76 Carter, President James E., 32 Catholicism, 18 central nervous system, 77, 105, 108, 109, 110 Chiron Corporation, 12, 37, 39 chromaffin cells, 57, 74 Cold Spring Harbor Laboratory, 58, 118 Colon-Hastings, Frances, 117 Columbia University, 53

D

Dallas, Texas, 72
Damon Runyon-Walter Winchell Cancer Fund, 67, 69, 71
Dana-Farber Cancer Institute, 74
De Vellis, Jean, 45
deoxyribonuclease I, 47, 50, 51
Dorchester, Massachusetts, 7

Е

Emory University, 118

F

Ford, President Gerald R., 32 Foxx, Jamie, 14 Freeport, New York, 1

G

Genentech, Incorporated, 72 glial cells, 77, 90 glucocorticoid, 49, 50 Gordon Research Conference, 82 Gralla, Edith B., 43, 46 grant writing, 51, 66, 67, 71, 80, 82, 83, 84, 85, 91, 92, 107, 109, 118, 119

H

halobacterium, 37 Hankinson, Noll, 45 Herschman, Harvey R., 43, 45, 47, 48, 49, 50, 51, 52, 53, 55, 56, 57, 66, 85, 86, 88 Hinterneder, Jeanine, 108, 121 Hood, Leroy E., 72 Howard Hughes Medical Institute, 67 Human Genome Project, 73, 103, 105, 112, 115

Ι

Island Park, New York, 1, 4, 5

J

Johnson, Jane E., 63, 64, 65, 67, 68, 71, 72 Joseph, Sheri, 10, 11, 13, 14, 15 Judaism, 2, 10, 18, 19, 20

K

Kennedy, President John F., 23 Kentfield, California, 1, 2 Korean War, 4, 5, 7

L

Lake George, New York, 7 Lander, Eric S., 72 Latterich, Martin, 66 Lerner, Aaron, 2, 18 Lerner, Ester, 2, 3 Long Beach, New York, 3, 4, 5 Los Angeles, California, 8, 14, 15, 41, 42, 45 Brentwood, 42 Lutheranism, 19

Μ

mammalian achaete-scute homologs, 65
Manhattan, New York, 3, 5, 20
Marin County, California, 1, 2, 15
Massachusetts Institute of Technology, 39, 41
mentoring, 38, 53, 84, 87, 119, 120
metallothionein, 49, 53
Michelsohn, Arie M., 57
Miller, Seth, 29, 33, 41, 42, 45
MIT. See Massachusetts Institute of Technology
multiple sclerosis, 88, 89, 90, 97, 104
MyoD, 64

Ν

National Alliance for Autism Research, 110 National Institute of General Medical Sciences Minority Access to Research Careers, 118 National Institutes of Health, 67, 71, 72, 80, 84, 111 Research Project Grant (R01), 72, 80, 82, 83, 118 National Labor Relations Board, 2, 5, 6 National Science Foundation, 80, 111, 113 *Nature*, 59, 65 neural crest cells, 57, 65, 74, 75, 76 *Neuron*, 59 New York University, 4, 14 New York, New York, 3, 4, 7, 13, 14, 15, 22 Newark, New Jersey, 5 norepinephrine, 76, 79

0

opsin, 37, 38

Р

parasympathetic nervous system, 79
Pasadena, California, 46, 60
Penhoet, Edward E., 37, 38, 39, 103
peripheral nervous system, 57, 77
Pew Charitable Trusts, 112
Science and Society Institute, 112
Pew Scholars Program in the Biomedical Sciences, 51, 66, 80, 88, 97, 98, 109, 118, 119
Portland, Oregon, 12
Princeton University, 31
Protestantism, 18, 19

R

Radcliffe College, 30 Rett Syndrome, 109 ricin, 48

S

San Diego, California, 15
San Francisco, California, 1, 2, 5, 6, 15, 16, 32, 41, 42, 45, 72 *Science*, 62, 65, 114
Simon, Melvin I., 46
Society for Neuroscience, 82, 112, 113
sympathetic nervous system, 57, 74, 75, 76,

78, 79

Т

Taplitz, Daniel, 8, 11, 13, 14, 15, 22, 24, 37 Taplitz, Frieda, 3, 4 Taplitz, Randy, 11, 12, 13, 17, 73 Taplitz, Richard, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 17, 18, 19, 20, 21, 22, 31, 32, 35, 94 Taplitz, Rudolf, 3, 4, 5, 36 Tapliz, Daniel, 11, 13, 21 tetradecanoyl phorbol acetate, 48 Tufts Medical Center, 12

Turrigiano, Gina G., 75

U

U.S. Social Security Administration, 5
UCLA. See University of California, Los Angeles
UCSF. See University of California, San Francisco
UNC. See University of North Carolina
Unitarian Universalism, 18, 19
University of California, Berkeley, 2, 12, 13, 16, 24, 28, 30, 31, 32, 33, 34, 36, 40, 41
School of Public Health, 39
University of California, Los Angeles, 39,

41, 42, 44, 45

Warren Hall, 44 University of California, San Francisco, 12, 39 University of California, Santa Cruz, 13, 31 University of Maryland, Baltimore County, 118 University of North Carolina, 72, 73, 74 University of San Francisco, 13 University of Texas Southwestern, 67, 72 University of Virginia, 4, 5

V

Verdi, Joseph M., 65

W

Washington, D.C., 1, 6, 17, 20, 111
White, Kalpana P., 102
Whitehall Foundation, 109
Whitehead Institute for Biomedical Research Center for Genome Research, 72
Woods Hole Oceanographic Institution, 89
World War II, 4
Wuenschell, Carol W., 68

Z

Zimmerman, Kathy, 68