

CHEMICAL HERITAGE FOUNDATION

**JACK D. KEENE**

The Pew Scholars Program in the Biomedical Sciences

Transcript of Interviews  
Conducted by

Arnold Thackray, Stephanie Morris, and David Caruso

at

Ixtapa, Mexico, and  
Johns Hopkins University, Baltimore, Maryland

on

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(With Subsequent Corrections and Additions)

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## **JACK D. KEENE**

1947 Born in Jacksonville, Florida, on 22 June

### Education

1969 AB, University of California, Riverside, Life Sciences

1974 PhD, University of Washington, Seattle, Microbiology and Immunology

### Professional Experience

1974-1978 National Institutes of Health, Bethesda, Maryland  
Staff Fellow, Molecular Genetics under Robert Lazzarini

1979-1984 Duke University Medical Center, Durham, North Carolina  
Assistant Professor, Department of Microbiology and Immunology

1985-present Associate Professor, Division of Rheumatology and Clinical Immunology, Department of Medicine

1984-1988 Associate Professor, Department of Microbiology and Immunology

1988-1992 Professor, Microbiology and Immunology

1995-2003 Director of Basic Science Research, Comprehensive Cancer Center

1992-2002 James B. Duke Professor and Chairman, Department of Microbiology and Immunology

2002-present James B. Duke Professor, Department of Molecular Genetics and Microbiology

### Honors

1981-1986 American Cancer Society, Faculty Research Award

1981-1984 Nanaline Duke Faculty Scholar

1985-1988 Arthritis Foundation, Devil's Bag Award

1986-1990 Pew Scholar in the Biomedical Sciences

present Fellow of the American Academy of Microbiology

present James Buchanan Duke Distinguished Professorship

present Member of the Henry Kunkel Honorary Society

## ABSTRACT

Jack Keene was born in Florida, one of four children. His father worked in early computers for the RAND Corporation, and the family moved numerous times. Keene finished high school in Redlands, California, and entered University of California, Los Angeles (UCLA), later transferring to University of California, Riverside. There he majored in biology, inspired and mentored by Carlton Bovell. Next he entered Helen Whiteley's lab at the University of Washington for a PhD in microbiology and immunology. While in graduate school he married. During his postdoc in Robert Lazzarini's lab at the National Institutes of Health (NIH) he learned classical sequencing, scientific discipline, and high standards. He loved the NIH, where he met many important scientists, had good funding, and found congenial the atmosphere at the NIH generally and in Lazzarini's lab in particular.

Keene accepted an assistant professorship at Duke University. There he worked on negative-strand RNA virology until he won the Pew Scholars award. Wolfgang Joklik, the chairman of Keene's department, became a very good mentor and friend. Keene studied how RNA virus works in autoimmune patients, using antibodies to study virus-host interactions; then cell components; eventually cell proteins. The work has engendered five publications so far, with five more coming, dealing with RNA-binding proteins. Keene obtained a patent on an autoimmune test kit, a patent he licensed to Duke and on which he consults; and he shares the royalties with his lab. He says the Pew Scholars award brought him notoriety, more academic work, and funding he was able to save for a low point. In five or ten years Keene hopes to understand basic principles of development of the human organism from fertilization to death.

In his second interview Jack Keene expands on his biographical information. He worked summers in Missouri at relatives' farms; worked at the US Salinity Laboratory while he was in graduate school; played guitar and sang, but only privately; took up the American Civil War as a hobby. His wife is an artist; she worked at the Smithsonian Institution while Keene was at the NIH; they have two grown children and some grandchildren.

Making an easy transition to an assistant professorship at Duke University and interested in what proteins interact with regulating regions, Keene sequenced vesicular stomatitis virus, which is associated with rabies, Ebola, and influenza. Wolfgang Joklik, the department chairman, became his mentor and good friend; he helped Keene obtain grants, including the Pew Scholars award, using which Keene discovered RNA recognition motif (RRM). This led to work on binding specificity. Finding the multibinding of specific sequences has led to Keene's post-transcription theory and in turn to a coordination theory of RNA operons.

Keene muses throughout the interview on a number of subjects. He found at least the first Pew meetings perhaps excessively luxurious, but he enjoyed the intellectual talk and the chance to get to know such famous scientists as Joshua Lederberg, Daniel Tosteson, Gerald Weissman. He discusses his own lab management; teaching students to write; evidence-based reasoning; funding's outsized role in competition for students and for the rush to publish. He says that science cannot be proved, only disproved; that truth equals functional truth. While on the Pew Scholars Program advisory committee he looked for imagination and passion in applicants. For a while he was department chairman but had to delegate his chairman duties in order to teach and run his lab. In fact, two subsequent Pew Scholars came from his lab. A merger of departments created the Center for RNA Biology for him.

Keene considers his discovery of the binding motif a major contribution to biochemistry. Having found the protein that regulates growth control messages, he switched to working in that area. Fen-Baio Gao, his student, got the protein to bind with brain RNAs; from that they discovered that translation activated RNAs into proteins, and this became the early core of the operon regulon model. Because this work was considered “odd,” it was hard to find funding, so he used some Pew money. Scott Tenenbaum, his postdoc, used microarrays for *in vivo* testing, a major turning point. Keene’s theory was hard to communicate and unpersuasive, but finally Keene got an *in vivo* hypothesis article published. The operon was discovered in mammals in Keene’s lab and later proved in yeast in Patrick Brown’s lab. Keene is now working on exosomes, microscopic particles that pass RNA operons among cells; this is a new direction, not yet credible, he says.

Keene concludes his interview with more general musings. He points out that there have been no RNA operon publications in *Science*. He believes that the NIH should spread funding around among investigator-initiated projects, not give blocks of money to large but often-unsuccessful projects like development of an AIDS vaccine. He talks about science ethics and the public trust; who should decide funding; and a lack of science understanding among citizens. He says that guidelines, oversight, and interest are needed on the part of the National Science Foundation’s outreach requirements; his own project was rejected. For assigning value to scientists and their work he compares the European system with the American. Projects these days are often too big and have too many authors, so young scientists are not recognized. Keene gives his opinions on innate genius versus luck; careerism versus professionalism; personal responsibility; and the importance of morals in rearing children. Keene believes that his work is extremely important. He reiterates his belief that truth equals functional truth.

## INTERVIEWERS

**Arnold Thackray** founded the Chemical Heritage Foundation and served the organization as president for 25 years. He is currently CHF’s chancellor. Thackray received MA and PhD degrees in history of science from Cambridge University. He has held appointments at Cambridge, Oxford University, and Harvard University, the Institute for Advanced Study, the Center for Advanced Study in the Behavioral Sciences, and the Hebrew University of Jerusalem. In 1983 Thackray received the Dexter Award from the American Chemical Society for outstanding contributions to the history of chemistry. He served for more than a quarter century on the faculty of the University of Pennsylvania, where he was the founding chairman of the Department of History and Sociology of Science and is currently the Joseph Priestley Professor Emeritus.

**David J. Caruso** earned a BA in the history of science, medicine, and technology from Johns Hopkins University in 2001 and a PhD in science and technology studies from Cornell University in 2008. Caruso is the director of the Chemical Heritage Foundation’s (CHF) Center for Oral History, president of Oral History in the Mid-Atlantic Region, and the book review editor for the *Oral History Review*. In addition to overseeing all oral history research at CHF, he also holds an annual training institute that focuses on conducting interviews with scientists and engineers, he consults on various oral history projects, like at the San Diego Technology Archives, and is adjunct faculty at the University of Pennsylvania, teaching courses on the

history of military medicine and technology and on oral history. His current research interests are the discipline formation of biomedical science in 20th-century America and the organizational structures that have contributed to such formation.



## TABLE OF CONTENTS

Early Years	1
Born in Missouri. Father software engineer in early computers, for RAND Corporation; family moved often. Worked on family farms in summers. Redlands [California] High School.	
College and Graduate School Years	3
Begins at UCLA; transfers to UC, Riverside. Molecular biology more revolutionary than chemistry or physics. Carlton Bovell's inspiration and mentorship. Helen Whiteley's microbiology lab at University of Washington for PhD. Whiteley's personality, lab management. Neal Groman's influence. Theodore Roszak's philosophy. Marries.	
Postdoc Years	7
Peter Vogt's work in tumor viruses. Enters Robert Lazzarini's virology lab at National Institutes of Health (NIH). Ample funding, collegial atmosphere at NIH; Lazzarini's lab like family. RNA sequencing; learns classical sequencing from Martin Rosenberg. High standards, discipline, though not much independent work.	
Becoming Faculty Member	12
Accepts assistant professorship at Duke University. Wolfgang Joklik's lab, management style, personality. Learning politics of science. Negative strand RNA virology until winning Pew award. Joklik good mentor and friend. NIH grants and several smaller grants. How RNA virus works in autoimmune patients. Publications. Patent on autoimmune test kit. Impact of Pew award. Future aspirations and goals.	

## SECOND INTERVIEW

Biographical Information	20
Parents' background. Keene's interests and hobbies. Good student. Enjoys science in school.	
College and Graduate School Years	31
Bovell's mentoring and inspiration. Science as quasi-religious search for truth. Wanted to be expert in one narrow area. Part-time work at US Salinity Laboratory. Helen Whiteley's lab at University of Washington.	
Postdoctoral Years	41
Robert Lazzarini's lab at NIH. Hope to work on viruses and cancer. Loves NIH. Wife works at Smithsonian. First child born; balancing home and work lives. Lazzarini's Italian warmth and assistance. Golden age of virology; gets to know many famous scientists at NIH.	

First Job	46
<p>Accepts assistant professorship at Duke University. Easy transition, with support from Wolfgang Joklik. Good students for lab. Interest in regulation. Joklik's personality, chairmanship. Learning politics of science. Joklik's help on Pew award application. Luxurious Pew meetings, collegiality. Getting to know famous scientists like Joshua Lederberg, Daniel Tosteson, Gerald Weissman. Intellectual talks. Results of Pew award money. Work on binding specificity. Tries to help younger scientists. Hands-off inspiration, but accessible. Designs but does not perform experiments. Teaching lab members to write.</p>	
Philosophical Observations	56
<p>Science adversarial, like law court. Publication expectations and requirements. Labs' competition for students. Judging quality of data; controls and repetition of experiments. Uncertainty in science. Position on journals' editorial boards.</p>	
Current Work	67
<p>Discovery of binding motif a major biochemical contribution. Work considered "odd." Pew Scholars Program advisory committee; looks for imagination, passion in applicants. Department chairman. Careerism versus professionalism. Two Pew Scholars from his lab. Merger of departments creates Center for RNA Biology. <i>In vivo</i> hypothesis article published. Operon discovered in mammals in Keene's lab, proved in yeast in Patrick Brown's lab. Work on exosomes.</p>	
More Philosophical Observations	87
<p>Kinds of papers he reviews for journals. No RNA operon publications in <i>Science</i>. Tries to help writers; always begins with positive comments. NIH funding, specifically for AIDS. "War on science" a nod to lack of public's understanding of science. Also indicates competition among scientists and schools for funding. Who should decide funding. Science ethics and public trust. Importance of science to human progress. "Romantic" period of science ending and "academic" period beginning. National Science Foundation (NSF) outreach requirements. Guidelines, oversight, interest needed on part of NSF. Value of internet in dispute. Assigning value to scientists and their work. European system compared with American. Careerism versus professionalism; personal responsibility. Frustration with system. Morals and child-rearing. Evaluation of his own work.</p>	
Index	119

## INDEX

### A

acquired immune deficiency syndrome, 13, 68, 98, 99, 100, 103, 111  
AIDS. *See* acquired immune deficiency syndrome  
Alberts, Bruce M., 103, 106, 109  
American Cancer Society, 13, 51  
American Civil War, 21, 28, 29, 30, 49, 109  
Andrews, Nancy, 84, 93  
Arthritis Foundation, 13, 76  
Axelrod, Julius, 10

### B

Baltimore, David, 116  
Berliner, Robert, 52, 53, 54, 55, 56  
Bethesda, Maryland, 7, 8, 43  
Bill and Melinda Gates Foundation, 78, 100  
Bishop, J. Michael, 7, 10, 11, 41, 42, 45  
Bovell, Carlton R., 3, 4, 31, 32, 35, 36  
Brandeis University, 72  
Breckenridge, Missouri, 1  
Brent, Roger, 79  
Brown, Patrick O., 90  
Bush, President George H.W., 101  
Bush, President George W., 101

### C

Case Western Reserve University, 93  
Cech, Thomas R., 91  
*Cell*, 15, 70, 86  
Chambers, Jasmine C., 86, 92  
Chance, Britton, 4, 32, 33  
Clinton, President William J., 103  
Cold Spring Harbor Laboratory, 38  
collaboration, 8, 46, 54, 74, 85, 104  
Colorado State University, 87  
competition, 14, 15, 47, 55, 84  
Crick, Francis H.C., 110  
Cunningham, Mr., 26

### D

DNA, 9, 14, 35, 47, 57, 72, 74, 88, 110  
Duke University, 2, 7, 9, 10, 11, 12, 15, 16, 17, 20, 31, 42, 43, 45, 46, 47, 49, 51, 52, 53, 54, 55, 65, 70, 76, 82, 93, 94, 99, 102  
Center for RNA Biology, 49, 88, 92  
Combinatorial Sciences Center, 49, 92  
Durham, North Carolina, 2, 28, 29, 111

### E

East Carolina University, 74  
Einstein, Albert, 12, 24, 43

### F

Fauci, Anthony S., 87  
Friday Harbor Laboratories, 38

### G

Gajdusek, Daniel C., 10  
Gao, Fen-Baio, 73, 74, 75, 89, 90, 92  
Glut-1 (Glucose-1 RNA), 74  
grants/funding, 10, 12, 13, 39, 40, 53, 54, 56, 60, 63, 68, 73, 74, 75, 78, 79, 80, 82, 84, 89, 92, 94, 95, 98, 100, 101, 102, 103, 104, 109, 115  
Groman, Neal B., 6, 40

### H

Hammes, Gordon, 81, 93  
Handler, Philip, 31, 82  
Harvard Medical School, 52  
Harvard University, 52, 53, 79, 102  
Haynes, Barton F., 99  
Herschlag, Daniel, 91  
HIV. *See* human immunodeficiency virus  
Holmes, Edward W., 93  
Hood, Leroy, 102, 109  
Howard Hughes Medical Institute, 52, 60, 78, 94, 103  
human immunodeficiency virus, 99, 111

### J

Janelia Research Campus, 94  
Joklik, Wolfgang K., 9, 10, 11, 12, 13, 16, 43, 45, 46, 48, 49, 50, 61, 81, 82, 84  
*Journal of Biological Chemistry*, 32, 70, 95

### K

Kaman, Robert, 73  
Kenan, Daniel J., 92  
Kennedy, Eugene P., 53, 77  
Khoury, George, 10  
King, Peter, 72, 73  
Klausner, Richard D., 103  
Kornberg, Arthur, 82  
Kurilla, Michael G., 87

## L

La protein, 57, 72, 86  
Langfitt, Thomas W., 53  
Latin American Fellows Program in the Biomedical Sciences, 79  
Lazzarini, Robert A., 7, 8, 9, 10, 11, 39, 41, 42, 43, 44, 45, 46, 47, 48, 61, 115  
Leder, Philip, 10, 45  
Lederberg, Joshua, 54, 55, 76, 77, 113  
Levine, Todd D., 73

## M

Massachusetts Institute of Technology, 1  
Minnesota Vikings, 117  
Missouri, 1, 3, 20, 22, 27, 44, 100  
Mitchell, Peter D., 4, 32, 33  
*Molecular and Cell Biology*, 95  
*Molecular Cell*, 89  
Moss, Bernard, 45

## N

National Academy of Sciences, 52, 71, 81, 82, 103, 116  
National Cancer Institute, 83, 102  
National Institute of Allergy and Infectious Diseases, 87  
National Institutes of Health, 7, 8, 9, 10, 11, 13, 37, 38, 39, 41, 42, 44, 45, 46, 47, 63, 68, 71, 80, 82, 87, 97, 98, 102, 103, 106, 110, 113, 115  
National Science Foundation, 102, 103, 111, 112  
*Nature*, 96  
NIH. *See* National Institutes of Health  
Nirenberg, Marshall W., 10  
Nobel Prize, 10, 11, 33, 37, 42, 55, 77, 92  
NSF. *See* National Science Foundation

## O

O'Neil, Edward H., 51

## P

Parker, Roy R., 91  
Pastan, Ira H., 10, 45  
patent, 15, 16, 78, 102  
Pauling, Edward Crellin, 32  
Pauling, Linus C., 32, 109  
Petes, Thomas D., 87  
Pew Charitable Trusts, 51, 100  
Pew Scholars Program in the Biomedical Sciences, 12, 13, 14, 18, 20, 50, 51, 52, 54, 55, 56, 69, 70, 73, 75, 76, 77, 78, 79, 80, 82, 86, 94, 100  
Pew, J. Howard, II, 77  
Pew, R. Anderson, 77

Piwnica-Worms, Helen M., 86, 87  
*Proceedings of the National Academy of Sciences*, 71  
*Public Library of Science*, 90, 94, 98  
*Biology*, 90  
publish/publication, 9, 10, 12, 14, 15, 32, 37, 40, 42, 56, 57, 62, 64, 70, 71, 72, 82, 85, 86, 89, 90, 91, 95, 96, 98, 113, 116

## Q

Query, Charles C., 86

## R

RAND Corporation, 2, 21, 23, 24  
Reagan, President Ronald W., 103  
Redlands, California, 3, 26, 30  
Reinhardt, Uwe E., 103  
religion, 32, 40, 114, 117, 118  
Christianity, 101, 117  
Protestantism  
Pentecostalism, 100  
Roman Catholicism, 100  
RNA, 7, 9, 12, 14, 15, 47, 49, 56, 57, 71, 72, 73, 74, 75, 87, 88, 90, 91, 93, 94, 96, 99, 110  
*RNA Biology*, 95  
RNA recognition motif, 56, 57, 72, 73  
Rockefeller University, 113, 116  
Rosenberg, Martin, 9  
Roszak, Theodore, 6  
RRM. *See* RNA recognition motif

## S

Sabiston, David C., 52  
San Francisco, California, 7, 8, 10, 11, 41, 43, 51, 74  
Scheller, Richard H., 79  
Schubert, Manfred, 10, 11  
*Science*, 89, 96  
Seattle, Washington, 3, 5, 7, 8, 35, 36, 41, 109  
Shockley, William, 100  
Singer, Maxine F., 10, 45  
Stanford University, 54, 79, 82, 90, 91  
State University of New York at Albany, 90  
Steitz, Joan A., 14, 56, 93, 96  
Stent, Gunther S., 6, 110

## T

Tenenbaum, Scott A., 75, 90, 92  
tenure, 12, 47, 70, 87, 113, 115  
Tosteson, Daniel C., 52, 56

## U

U.S. *See* United States of America

U.S. Air Force Academy, 28  
U.S. Navy, 21  
U.S. Salinity Laboratory, 35  
UCLA. *See* University of California, Los Angeles  
United States of America, 2, 85, 86, 98, 107, 113  
University of California, Los Angeles, 3, 29, 30, 105  
University of California, Riverside, 3, 4, 5, 30, 32,  
35  
University of California, San Francisco, 76  
University of Pennsylvania, 32, 102  
University of Southern California, 7  
University of Tennessee, 17  
University of Washington, 3, 4, 35

## V

Varmus, Harold E., 7, 10, 11, 41, 42, 45, 82, 103  
Vietnam War, 6, 28, 30, 40  
Vogt, Peter K., 7, 41

von Eschenbach, Andrew C., 83

## W

W.M. Keck Foundation, 95  
Washington University in St. Louis, 87  
Watson, James D., 110  
Weissmann, Gerald, 55  
White, Kalpana P., 72  
Whiteley, Arthur, 38  
Whiteley, Helen R., 4, 5, 7, 9, 35, 38, 39, 40, 41, 44,  
45  
Wiesel, Torsten N., 77  
Wilusz, Jeffrey, 86, 87  
World War II, 1, 21, 24, 28

## Y

Yale University, 14, 52, 56, 76, 79, 82, 93, 96